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NATIONAL DAM INSPECTION PROGRAM. UPPER CASTANEA RESERVOIR DAM. --ETC(U)
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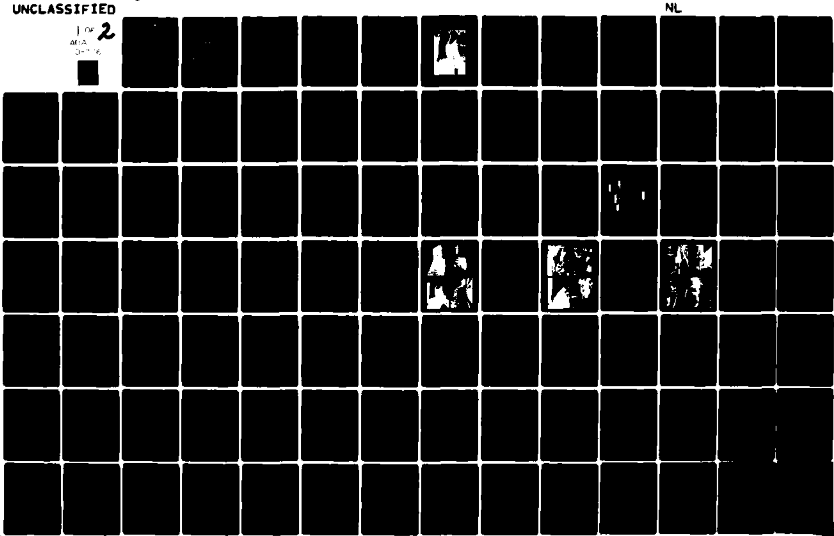

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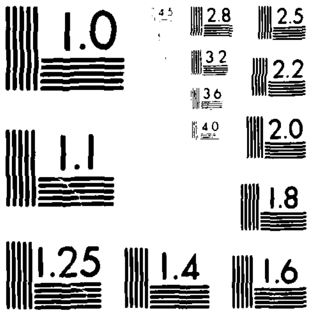

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS

LEVEL IV

SUSQUEHANNA RIVER BASIN
HARVEY'S RUN, CLINTON COUNTY

PENNSYLVANIA

UPPER CASTANEA RESERVOIR DAM

(NDI I.D. No. PA-00393
PENNDER I.D. No. 18-7)

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

PREPARED FOR

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

PREPARED BY

GAI CONSULTANTS, INC.
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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topograhic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

ABSTRACT

Upper Castanea Reservoir Dam: NDI No. PA-00393

Owner:	City of Lock Haven
State Located:	Pennsylvania (PennDER I.D. No. 18-7)
County Located:	Clinton
Stream:	Harvey's Run
Inspection Date:	21 April 1980
Inspection Team:	GAI Consultants, Inc. 570 Beatty Road Monroeville, Pennsylvania 15146

Based on a visual inspection, operational history, and hydrologic/hydraulic analysis, the dam is considered to be in fair condition.

The size classification of the facility is small and its hazard classification is high. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) ranges between the 1/2 PMF (Probable Maximum Flood) and the PMF. Due to the high potential for damage to downstream structures and possible loss of life, the SDF is considered to be the PMF. Results of the hydrologic and hydraulic analysis indicate the facility will pass and/or store only about 40 percent of the PMF prior to embankment overtopping. A breach analysis indicates that failure under less than 1/2 PMF conditions could lead to increased property damage and possible loss of life in the downstream reaches. Thus, based on the screening criteria contained in the recommended guidelines, the spillway is considered to be seriously inadequate and the facility unsafe, non-emergency.

It is recommended that the owner immediately:

a. Have the facility evaluated by a registered professional engineer experienced in the hydraulics and hydrology of dams to further assess the discharge capacity of the spillway facilities and take remedial measures deemed necessary to make the facility hydraulically adequate.

b. Proceed with the proposed plans to rehabilitate the outlet works.

c. Assess the status and operability of the auxiliary blowoff conduit and restore and/or provide upstream control.

d. Uncover the outlet end of the primary blowoff pipe and assess the origin and extent of seepage and/or leakage at this location during the rehabilitation of the outlet works.

e. Provide adequate erosion protection of the left channel wall immediately downstream of the spillway.

f. Specifically observe the saturated area along the downstream embankment toe near the left abutment in all future inspections.

g. Formalize manuals of maintenance and operation to ensure proper future care of the facility. Included in the manuals should be the established reservoir monitoring procedures.

GAI Consultants, Inc.

Bernard M. Mihalcin, P.E.

Approved by:

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
BERNARD M. MIHALCIN
ENGINEER
20371-E

Date 10 July 1980

Date 31 July 198

OVERVIEW PHOTOGRAPH

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
UPPER CASTANEA RESERVOIR DAM
NDI#PA-00393, PENNDER #18-7

SECTION 1
GENERAL INFORMATION

1.0 Authority.

The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

1.1 Purpose.

The purpose is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Upper Castanea Reservoir Dam is a 27-foot high earth embankment approximately 274 feet long, including spillway. The facility is constructed with a free overfall, rectangular, concrete chute channel spillway located at the right abutment. Discharges are controlled by a round crested, triangular shaped weir structure. An intake tower (currently dilapidated, but, scheduled for renovation) is located near the axis of the dam on the upstream slope. Drawdown capability is provided from the tower through an 18-inch diameter cast iron pipe. Auxiliary drawdown may be available through a 12-inch diameter pipe that originates in the spillway forebay; however, its operability is unknown.

b. Location. Upper Castanea Reservoir Dam is located on Harvey's Run in Castanea Township, Clinton County, Pennsylvania. The city of Lock Haven, Pennsylvania is situated about two miles to the northwest. The dam and reservoir are contained within the Loganton, Pennsylvania 7.5 minute U.S.G.S. topographic quadrangle (see Figure 1, Appendix E). The coordinates of the dam are N41° 7.0' and W77° 25.2'.

c. Size Classification. Small (27 feet high, 43 acre-feet storage capacity at top of dam).

d. Hazard Classification. High (see Section 3.1.e).

e. Owner. City of Lock Haven
20 East Church Street
Lock Haven, Pennsylvania 17745
Attention: Richard Marcinkevage
City Engineer

f. Purpose. Water supply.

h. Historical Data. Upper Castanea Reservoir Dam (previously called the Upper Harvey's Run Dam) was originally constructed in 1869 as a small earthfill dam. A concrete and wood plank spillway was rebuilt in 1889 after flooding overtopped and damaged the original facility. In 1927 the facility was totally rehabilitated. The spillway was replaced by a concrete structure while the geometry and internal features of the embankment were substantially altered (see Figures 3 and 4). The facility remained essentially unchanged through 1979 when the downstream slope was regraded. Throughout the 1927-79 period the facility has functioned adequately; however, historical reports indicate persistent seepage under the spillway, around the 18-inch diameter blowoff conduit and along the left abutment toe. Lower Castanea Reservoir Dam, located about 1,200 feet downstream from Upper Castanea Reservoir Dam, was overtopped and breached during the flood of June 1972. The owner is currently in the process of renovating the outlet works of the upper dam.

1.3 Pertinent Data.

a. Drainage Area (square miles). 2.77

b. Discharge at Dam Site.

Discharge Capacity of Outlet Conduit - Discharge curves are not available.

Discharge Capacity of Spillway at Maximum Pool ≈ 1740 cfs (see Appendix D, Sheet 10).

c. Elevation (feet above mean sea level). The following elevations were obtained from available drawings and through field measurements based on the elevation of the spillway crest at 838.5 feet (see Appendix D, Sheets 1 and 2).

Top of Dam	842.7 (field). 843.0 (design).

Maximum Design Pool	Not known.
Maximum Pool of Record	Not known.
Normal Pool	838.5
Spillway Crest	838.5
Upstream Inlet Inverts	
12-inch ϕ blowoff	822.0 (estimated).
18-inch ϕ blowoff	822.7
Downstream Outlet Inverts	
12-inch ϕ blowoff	816.0
18-inch ϕ blowoff	816.0 (estimated)
Streambed at Dam Centerline	818.0 (estimated).
Maximum Tailwater	Not known.

d. <u>Reservoir Length (feet)</u>.

Top of Dam	950
Normal Pool	650

e. <u>Storage (acre-feet)</u>.

Top of Dam	43
Normal Pool	33
Design Surcharge	Not known.

f. <u>Reservoir Surface (acres)</u>.

Top of Dam	2.7
Normal Pool	2.2
Maximum Design Pool	Not known.

g. <u>Dam</u>.

Type	Earth.
Length	220 feet (excluding spillway).
Height	27 feet (field measured; embankment crest to invert of 12-inch diameter blowoff).
Top Width	152 feet (maximum). 23 feet (minimum).
Upstream Slope	3H:1V
Downstream Slope	3H:1V

Zoning	None indicated.
Impervious Core	Two-foot thick concrete corewall with 30-inch base (see Figure 3).
Cutoff	Steel sheet piling in 20-foot lengths driven below corewall.
Grout Curtain	Not indicated in design drawings; however, available correspondence indicates that foundation grouting was being considered during 1927 reconstruction. No grouting records are available.

h. <u>Diversion Canal and Regulating Tunnels</u>. None.

i. <u>Spillway</u>.

Type	Free overfall, rectangular, reinforced concrete chute channel with a round crested, triangular shaped weir structure.
Crest Elevation	838.5 feet.
Crest Length	54 feet.

j. <u>Outlet Works</u>.

Type	Supply - 10-inch diameter cast iron pipe with 8-inch diameter stream intake by-pass (see Figures 2 and 5). Blowoff - 18-inch diameter cast iron

	pipe (primary outlet); auxiliary 12-inch diameter pipe originates at spillway forebay (incorrectly shown as an 8-inch diameter pipe in Figure 2).
Length	Approximately 150 feet (rough estimate; 18-inch diameter pipe inlet to blowoff outlet).
Closure and Regulating Facilities	Flow through 10-inch diameter supply pipe and 18-inch diameter blowoff are controlled by valves located at the intake tower along the upstream slope of dam. Owner plans to renovate intake tower (see Figures 5 and 6). 12-inch diameter blowoff has one known valve at the downstream toe, but, reportedly is also valved at the inlet.
Access	Intake tower is presently inaccessible, but, will be accessible upon the completion of the planned renovations.

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Design Data Availability and Sources. No design reports, calculations, or formal design data are available. Pertinent information in the form of design drawings (dated 1927), state inspection reports, dated photographs, contract specifications (1927 renovation), semi-monthly construction progress reports, and miscellaneous correspondence are contained in PennDER files. In addition, the owner has several drawings (dated 1980) relative to the current project rehabilitation available at the office of the city engineer.

b. Design Features.

1. Embankment. Available data indicates the embankment was constructed in 1927 atop an existing earthen structure as shown in Figure 3. Correspondence contained in PennDER files reveals that the old embankment was composed of poor quality material without a cutoff trench or impervious zone. Consequently, a concrete corewall, cutoff trench and steel sheet piling were incorporated into the 1927 design. The surface of the old embankment was reportedly stripped and rolled earthfill placed on each side of the corewall in 8-inch layers (see Figure 3). The design made available to the owner several alternatives for the final height and configuration of the structure; however, no as-built drawings are available and the configuration has been altered with placement of additional material since 1927.

Currently, the embankment measures about 27 feet high and 274 feet long, including spillway. The crest width varies from a minimum 23 feet adjacent the spillway to a maximum 152 feet near the left abutment. Both the upstream and downstream slopes vary only slightly from 3H:1V.

2. Appurtenant Structures.

a) Spillway. The spillway, as reconstructed in 1927, is a free overfall, reinforced concrete, chute channel with a round crested, triangular shaped weir (see Figures 3 and 4). As previously indicated, the present spillway was constructed atop the original spillway, incorporating the original concrete walls into the new design. The drawings show that much of the concrete floor is supported by a series of 18-inch thick concrete walls surrounded by rock fill. The crest is supported by an extension of the concrete corewall that runs the length of the embankment. The original wood plank floor appears to have been removed; however, the original crib wall in the spillway forebay may still remain. Figure 4 also shows a valve and access platform within the spillway approach channel to control flow in the auxiliary 12-inch diameter blowoff line. The operability of this valve is presently unknown.

Visual inspection indicated that the spillway surfaces have been gunited; however, no records of when the work was performed are available.

b) Outlet Works. A schematic of the existing outlet works piping is shown on Figure 5. As indicated the supply line consists of a 10-inch diameter pipe and 8-inch diameter by-pass line that accepts flow directly from the stream above the reservoir. An 18-inch diameter primary blowoff outlet is also shown that discharges at the downstream toe of the embankment. A 12-inch diameter auxiliary blowoff is shown on Figures 2 and 3 which originates within the spillway forebay and discharges adjacent to the 18-inch diameter blowoff at the downstream toe. All outlets are apparently valved near their inlets and also within the downstream slope of the dam (see Appendix A, General Plan).

c. Specific Design Data and Criteria. No formal design reports, calculations, or specific design data are available for any aspect of this facility.

2.2 Construction Records.

Construction records are limited to the available drawings, specifications and dated photographs, and miscellaneous correspondence contained in PennDER files.

2.3 Operational Records.

No formal records of daily operations are maintained for the facility. A rain gage is located at the sewage treatment plant in Lock Haven. The owner intends to install a staff gage at the facility during the current rehabilitation program.

2.4 Other Investigations.

Other than periodic state inspections and the work associated with the 1927 renovation, there are no records of other formal investigations.

2.5 Evaluation.

The available data are considered adequate to make a reasonable Phase I evaluation of the facility.

SECTION 3
VISUAL INSPECTION

3.1 Observations.

a. General. The general appearance of the facility indicates the dam and its appurtenances are currently in fair condition.

b. Embankment. Observations made during the visual inspection indicate the embankment is in good condition. No evidence of sloughing, erosion, excessive settlement, or animal burrows was apparent (see Photograph 6). A small saturated area was observed near the toe of the extended downstream slope; however, it did not appear to be significant at the time of inspection. Also, some seepage or leakage was noted in the channel downstream of the 18-inch diameter blowoff line (see Photograph 8).

c. Appurtenant Structures.

1. Spillway. Visual inspection revealed the spillway to be in good condition. Some minor cracking and efflorescence were observed on the gunited spillway crest, channel, and sidewalls (see Photograph 3). Significant erosion has occurred along the left bank of the discharge channel, just downstream of the spillway (see Photograph 10).

2. Outlet Conduit. The operability of each of the outlet conduits is unknown, since neither the 18-inch diameter primary blowoff nor the 12-inch diameter auxiliary blowoff was operated in the presence of the inspection team. The above pool portion of the intake structure was observed to be badly deteriorated (see Photograph 4). It is noted, however, that the owner has currently let a contract to completely rehabilitate the structure and the valve mechanisms (see Figures 5 and 6). As noted above, some seepage or leakage was observed in the channel downstream of the 18-inch diameter primary blowoff line. Its outlet was covered by rock, soil, and debris, apparently from the recent regrading operation (see Photograph 8).

d. Reservoir Area. The general area surrounding the reservoir is composed of steep and heavily wooded slopes (see Photograph 2). No signs of slope distress were observed.

e. Downstream Channel. From the dam, Harvey's Run flows in a northwesterly direction through a moderately sloped, narrow valley, toward the community of Castanea, Pennsylvania located less than one mile downstream, and then enters Bald Eagle Creek. Lower Castanea Reservoir Dam, located about 1,200 feet downstream of Upper Castanea Reservoir Dam, was breached in the flood of June 1972 and provides no obstruction to dam outflows. At least 25 structures line the downstream channel between the dam and Bald Eagle Creek, and it is estimated that more than 100 persons could be affected by large flows associated with the failure of this facility (see Photographs 11 and 12). Consequently, the hazard classification is considered to be high.

3.2 Evaluation.

The overall condition of the facility is considered to be fair. Deficiencies noted by the inspection team include a saturated area near the toe of the embankment, which should be observed in future inspections, some seepage or leakage in the channel downstream of the main blowoff and significant erosion at the end of the left spillway sidewall. The debris which covers the outlet to the main blowoff should be cleaned out, and the source of this flow should be determined. Also, it may be necessary to monitor this flow. The owner stated that a contract to rehabilitate the outlet works has been let. The condition of the auxiliary blowoff line should also be assessed and upstream control restored or provided.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Normal Operating Procedure.

Upper Castanea Reservoir Dam is essentially a self-regulating facility. Excess inflow is automatically discharged through the uncontrolled spillway. Presently, all valves on the outlet works are closed except for the upstream inlet which is always open. Flow through the supply line is controlled by a pressure regulator located downstream of the dam. No formal operations manual is available; however, standard procedures will reportedly be formalized upon completion of current renovations.

4.2 Maintenance of Dam.

No formal maintenance procedures are established and no maintenance manual is available. The facility is currently undergoing a series of extensive renovations. At present, maintenance is performed on an as-needed basis by city of Lock Haven personnel.

4.3 Maintenance of Operating Facilities.

See Section 4.2 above.

4.4 Warning System.

The city of Lock Haven has established a formal reservoir monitoring procedure which is applicable for all of their water impounding facilities. The plan includes around-the-clock surveillance procedures during periods of unusually heavy precipitation.

4.5 Evaluation.

The facility is currently undergoing extensive renovations. It is reported that upon completion of the remedial work formal manuals of operations and maintenance are to be developed. These manuals are recommended to ensure the future proper care and operation of the facility. The established reservoir monitoring procedures should be incorporated into these manuals.

SECTION 5
HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data.

No formal design reports are available. Information contained in PennDER files indicates that the spillway was designed with a discharge capacity of about 1900 cfs which was considered ample in 1927.

5.2 Experience Data.

Daily records of reservoir levels and/or spillway discharge are not available. Discussions with the owner's representative indicated the largest flood in recent years occurred in June 1972. Heavy flows during this flood resulted in the overtopping and breaching of Lower Castanea Reservoir Dam, a much smaller facility located about 1,200 feet downstream. Upper Castanea Reservoir Dam was reported not to have overtopped during this flood.

5.3 Visual Observations.

On the date of inspection, no conditions were observed that would indicate the spillway could not function satisfactorily during a flood event, within the limits of its design capacity.

5.4 Method of Analysis.

The facility has been analyzed in accordance with the procedures and guidelines established by the U. S. Army, Corps of Engineers, Baltimore District, for Phase I hydrologic and hydraulic evaluations. The analysis has been performed utilizing a modified version of the HEC-1 program developed by the U. S. Army, Corps of Engineers, Hydrologic Engineering Center, Davis, California. Analytical capabilities of the program are briefly outlined in the preface contained in Appendix D.

5.5 Summary of Analysis.

a. Spillway Design Flood (SDF). In accordance with the procedures and guidelines contained in the National Guidelines for Safety Inspection of Dams for Phase I Investigations, the Spillway Design Flood (SDF) for Upper Castanea

Reservoir Dam ranges between the 1/2 PMF (Probable Maximum Flood) and the PMF. This classification is based on the relative size of the dam (small), and the potential hazard of dam failure to downstream developments (high). Due to the high potential for downstream damage and loss of life, the SDF for this facility is considered to be the PMF.

b. Results of Analysis. Upper Castanea Reservoir Dam was evaluated under normal operating conditions. That is, the reservoir was assumed to initially be at its normal pool or spillway elevation of 838.5 feet, with the low level blowoff lines closed and the spillway discharging freely. The 10-inch diameter supply line is normally open, however, its draw on the reservoir was considered to be insignificant due to its small discharge capacity. The spillway is a free overfall, rectangular, reinforced concrete chute channel, with discharges controlled by a round crested, triangular shaped weir structure.

The total reservoir drainage area was divided into three separate subareas in the analysis in order to more accurately assess the runoff characteristics of the total basin (Appendix E, Figure 1). Reservoir storage values below normal pool were estimated from a capacity curve obtained from the owner. The necessary downstream channel routing was done under the assumption that the stream was dry prior to the inflow of the dam outflow. All pertinent engineering calculations relative to the evaluation of this facility are provided in Appendix D.

Overtopping analysis (using the Modified HEC-1 Computer Program) indicated that the discharge/storage capacity of Upper Castanea Reservoir Dam can accommodate only about 40 percent of the PMF (SDF) prior to embankment overtopping (Appendix D, Summary Input/Output Sheets, Sheet K). The low top of dam was inundated by depths of water of 0.5 and 2.3 feet under the 1/2 PMF and PMF events, respectively (Summary Input/Output Sheets, Sheet K). Therefore, since the SDF for this facility is the PMF, Upper Castanea Reservoir Dam has a high potential for overtopping, and thus, for breaching under floods of less than PMF magnitude.

Since Upper Castanea Reservoir Dam cannot safely handle a flood of at least 1/2 PMF magnitude, the possibility of embankment failure under floods of 1/2 PMF intensity or less was investigated (in accordance with Corps directive ETL-1110-2-234). Several feasible alternatives were analyzed since it is difficult, if not impossible, to determine exactly how or if a specific dam will fail. The major concern of the breaching evaluations is with the impact of the various breach discharges on increasing downstream water surface elevations above those to be expected if breaching did not occur.

The Modified HEC-1 Computer Program was used for the breaching analysis with the assumption that the breaching of an earth dam would begin once its reservoir's water level reached the low top of dam elevation.

Two sets of breach geometry were evaluated for the Upper Castanea Reservoir Dam for each of two failure times (Appendix D, Sheet 18). The two breach sections chosen were considered to be the minimum and maximum probable failure sections. The two failure times (total time for each breach section to reach its final dimensions) under which the two breach sections were investigated were assumed to be a rapid time (0.5 hours) and a prolonged time (4.0 hours), so that a range of this most sensitive variable might be examined. In addition, an average set of breach conditions was analyzed, with a failure time of 1.0 hour.

The maximum section, in the case of the Upper Castanea Reservoir Dam, refers to the probable largest breach section through the thin portion of the dam. The embankment consists of a broad portion for a length of approximately 110 feet, and a thin portion for a length of approximately 110 feet (Appendix D, Sheet 19). It is assumed that the thin portion would fail before the broad portion, and thus, the broad portion would probably not contribute to the failure outflows. Also, since the dam has a concrete corewall, the possibility of an instantaneous or near-instantaneous embankment failure exists. However, time limitations within the Modified HEC-1 Computer Program prohibited the evaluation of such a failure.

The peak breach outflows (resulting from a 0.41 PMF overtopping) ranged from about 1,770 cfs for the minimum section-maximum fail time scheme to about 2,900 cfs for the maximum section-minimum fail time scheme (Appendix D, Sheet 20). The peak outflow for the average breach scheme was about 2,320 cfs, compared to the non-breach 0.41 PMF peak outflow of about 1,770 cfs (Summary Input/Output Sheets, Sheets Q and K). At Section 9 (see Figure 1), located about 3820 feet downstream from the dam, the maximum water surface elevation resulting from the average breach scheme was about 0.5-foot above the 0.41 PMF non-breach elevation, and above the damage levels of some of the residences. At Section 10 (see Figure 1), located about 4780 feet downstream from the dam, the peak water level resulting from the average breach scheme was about 1.8 feet above the maximum non-breach elevation, and again, above the damage levels of some of the residences. It is noted, however, that even under non-breach 0.41 PMF conditions, there would be some damage at Section 10 (see Appendix D, Sheets 17, 21).

The consequences of dam failure can be better envisioned if not only the increase in the height of the floodwave is considered, but also the great increase in the momentum of the larger and probably swifter moving volume of water. In addition, there is the possibility of a more severe (more rapid) failure than was considered here, due to the presence of a concrete corewall within the embankment. Therefore, the failure of Upper Castanea Reservoir Dam is quite possible, and will most probably lead to increased property damage and possibly to increased loss of life within the downstream community.

5.6 Spillway Adequacy.

As presented previously, under existing conditions, Upper Castanea Reservoir Dam can accommodate only 40 percent of the PMF (SDF) prior to embankment overtopping. Should a 0.41 PMF or larger event occur, the dam would be overtopped and could possibly fail, endangering the residences and increasing the potential for loss of life in the downstream community. Therefore, the spillway is considered to be seriously inadequate.

SECTION 6
EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Embankment. Based on visual observations, the embankment appears to be in good and stable condition. There is no erosion evident on the recently regraded downstream slope or on the upstream slope. Minor seepage was noted near the downstream toe of the extended section near the left abutment, but, is considered insignificant. Substantial flow was observed in the discharge channel downstream of the primary blowoff outlet. The source of flow could not be ascertained as the blowoff outlet apparently was inadvertently covered by rock and debris during the recent regrading work.

b. Appurtenant Structures.

1. Spillway. The spillway structure appears adequately maintained and in good condition. Significant erosion has occurred at the lower left end of the spillway and should be repaired. The spillway structure has been gunited and exhibits some cracking and efflorescence, but, appears structurally sound.

2. Outlet Works. The intake tower is currently dilapidated, but, due for major renovation (see Figures 5 and 6). Upstream control is provided on all pipes discharging from the tower and will be maintained in the renovation. The status and operability of the auxiliary blowoff line that originates in the spillway forebay area is unknown and should be assessed during the planned renovation.

6.2 Design and Construction Techniques.

Available data indicates that the existing facility contains the essential elements of modern design. The owner is actively renovating the facility to restore and/or maintain operability of essential elements.

6.3 Past Performance.

Available data indicates the facility has satisfactorily performed since the major renovation in 1927. The flood of June 1972 was passed successfully although the owner indicated that fill was added to the embankment crest during the storm to preclude overtopping. Leakage at the blowoff conduit, spillway toe and left abutment have been historically noted.

6.4 Seismic Stability.

The dam is located within Seismic Zone No. 1 and, thus, may be subject to minor earthquake induced dynamic forces. As the embankment appears statically stable, it is believed that it can withstand the anticipated dynamic forces; however, no calculations and/or investigations were performed to confirm this opinion.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The visual inspection suggests the facility is in fair condition.

The size classification of the facility is small and its hazard classification is high. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) ranges between the 1/2 PMF (Probable Maximum Flood) and the PMF. Due to the high potential for damage to downstream structures and possibly loss of life, the SDF is considered to be the PMF. Results of the hydrologic and hydraulic analysis indicate the facility will pass and/or store only about 40 percent of the PMF prior to embankment overtopping. A breach analysis indicates that failure under less than 1/2 PMF conditions could lead to increased property damage and possibly loss of life in the downstream reaches. Thus, based on the screening criteria contained in the recommended guidelines, the spillway is considered to be seriously inadequate and the facility unsafe, non-emergency.

Deficiencies noted by the inspection team include seepage or leakage from the primary blowoff outlet conduit, a debris covered outlet end on the conduit, erosion at the left downstream end of the spillway, a minor saturated area near the left downstream toe of the embankment and a dilapidated intake tower (currently being renovated).

b. Adequacy of Information. The available data are considered sufficient to make a reasonable Phase I assessment of the facility.

c. Urgency. The recommendations and studies listed below should be implemented immediately.

d. Necessity for Additional Studies. Additional studies to further assess the adequacy of the spillway system are considered necessary.

7.2 Recommendations/Remedial Measures.

It is recommended that the owner immediately:

a. Have the facility evaluated by a registered professional engineer experienced in the hydraulics and hydrology of dams to further assess the discharge capacity of the spillway facilities and take remedial measures deemed necessary to make the facility hydraulically adequate.

b. Proceed with the proposed plans to rehabilitate the outlet works.

c. Assess the status and operability of the auxiliary blowoff conduit and restore and/or provide upstream control.

d. Uncover the outlet end of the primary blowoff and assess the origin and extent of seepage and/or leakage at this location during the rehabilitation of the outlet works.

e. Provide adequate erosion protection of the left channel wall immediately downstream of the spillway.

f. Specifically observe the saturated area along the downstream embankment toe near the left abutment in all future inspections.

g. Formalize manuals of maintenance and operation to ensure proper future care of the facility. Included in the manuals should be the established reservoir monitoring procedures.

APPENDIX A

VISUAL INSPECTION CHECKLIST AND FIELD SKETCHES

CHECK LIST
VISUAL INSPECTION
PHASE 1

NAME OF DAM Upper Castanea Reservoir Dam STATE Pennsylvania COUNTY Clinton

NDI # PA — 00393 PENNDER # 18-7

TYPE OF DAM Earth SIZE Small HAZARD CATEGORY High

DATE(S) INSPECTION 21 April 1980 WEATHER Clear TEMPERATURE 60° @ Noon

POOL ELEVATION AT TIME OF INSPECTION 838.6 M.S.L.

TAILWATER AT TIME OF INSPECTION N/A M.S.L.

INSPECTION PERSONNEL	OWNER REPRESENTATIVES	*OTHERS*
B. M. Mihalcin	R. Marcinkevage (City Engineer)	
D. J. Spaeder	Stan Stukel (Supt.)	
W. J. Veon		

RECORDED BY B. M. Mihalcin

EMBANKMENT

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA- 00393
SURFACE CRACKS	None observed.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None observed. Crest and downstream slope of embankment were regraded in 1979.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Good alignment. Crest roadway (10-12 feet) consists of 3 to 4 inches of crushed limestone, placed in 1979 during regrading.
RIPRAP FAILURES	None observed. Riprap is partially covered by fine crushed rock and some sod. Good condition.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good condition.

EMBANKMENT

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA- 00393
DAMP AREAS IRREGULAR VEGETATION (LUSH OR DEAD PLANTS)	Small damp (saturated) area near toe of extended downstream slope (left abutment). Presently insignificant. Observe in future inspections.
ANY NOTICEABLE SEEPAGE	Seepage or leakage (20 - 30 GPM) in channel downstream of 18-inch blowoff. Outlet has been covered by soil/rock/debris during regrading. Should expose outlet and determine source of flow - possibly monitor.
STAFF GAGE AND RECORDER	Paint marks in 6-inch increments on *right wall of spillway. New staff* gage to be installed.
DRAINS	None observed.
ROCK OUTCROPS	Massive to thinly bedded hard red sandstone (fine-grained) outcrops just upstream of embankment. Bedding planes strike 15° to the centerline of dam and dip 40° to horizontal.

OUTLET WORKS

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA- 00393
INTAKE STRUCTURE	Above pool portion is dilapidated wooden structure. Contract has been let to rehabilitate entire outlet system.
OUTLET CONDUIT (CRACKING AND SPALLING OF CONCRETE SURFACES)	Not observed. Cast iron pipes with intakes submerged.
OUTLET STRUCTURE	None. Outlets discharge into rock-lined ditches. End of main 18-inch blowoff covered during regrading by rock/soil/and debris. Should be uncovered.
OUTLET CHANNEL	Rock-lined ditches.
GATE(S) AND OPERATIONAL EQUIPMENT	Presently 3 valves within intake tower which may be operable. Tower being renovated. One or two valves on auxiliary blowoff from spillway - operability and status unknown. Should ascertain.

EMERGENCY SPILLWAY

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA- 00393
TYPE AND CONDITION	Free overfall, rectangular, reinforced concrete chute channel with round crested, triangular shaped weir. Good condition. Surface gunited in 1963 or 64. Surfaces intact but exhibit random cracking and efflorescence.
APPROACH CHANNEL	Unobstructed. Appears to be rock lined within sidewalls.
SPILLWAY CHANNEL AND SIDEWALLS	Good condition with only random cracking in gunited surface.
STILLING BASIN PLUNGE POOL	None. Discharges into natural stream.
DISCHARGE CHANNEL	Natural rock and soil lined stream channel. Significant erosion has occurred at end of left spillway sidewall. Should be backfilled with large rock as erosion may impinge on toe of dam.
BRIDGE AND PIERS EMERGENCY GATES	None.

SERVICE SPILLWAY

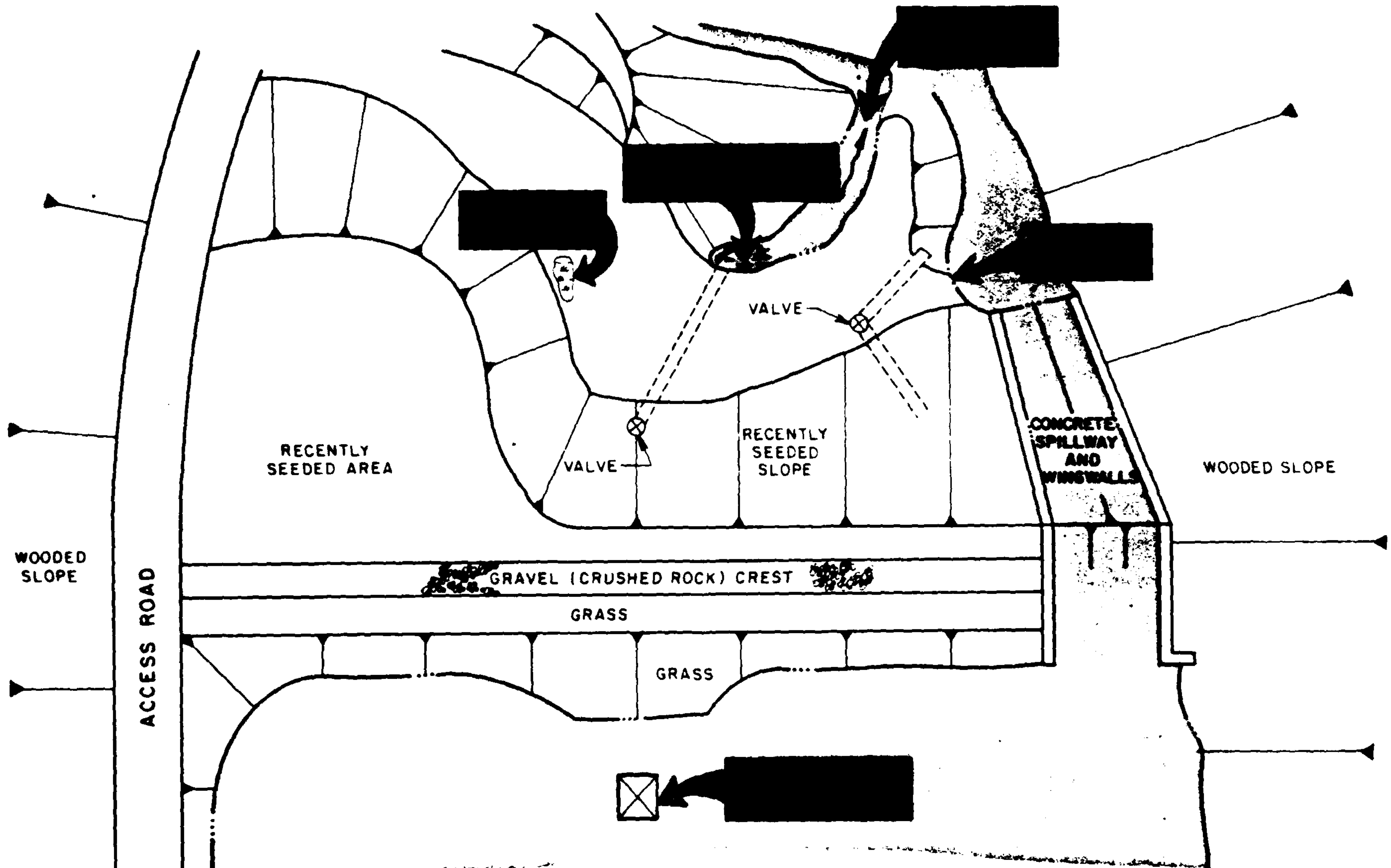
ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 00393
TYPE AND CONDITION	N/A
APPROACH CHANNEL	N/A
OUTLET STRUCTURE	N/A
DISCHARGE CHANNEL	N/A

INSTRUMENTATION

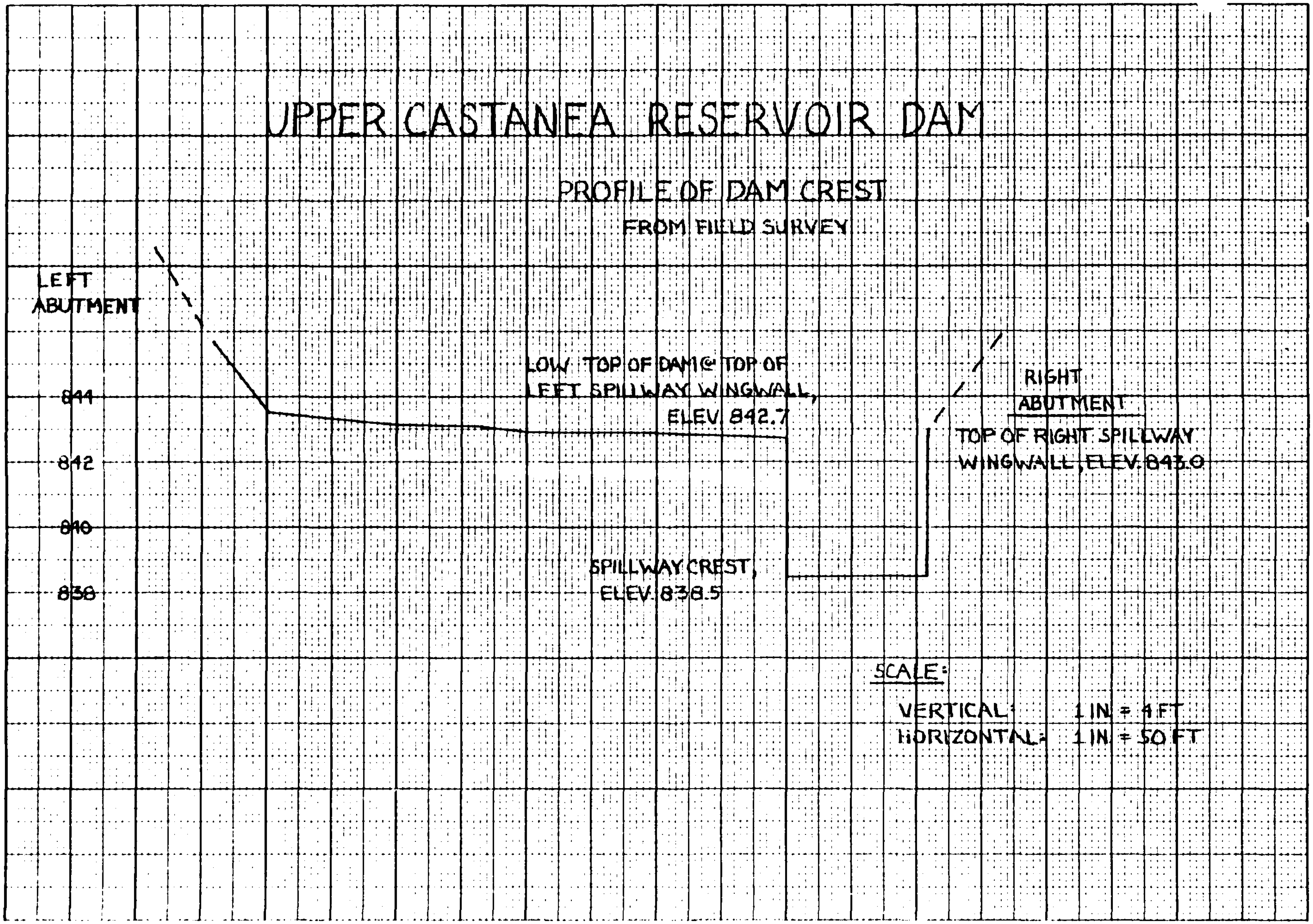
ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA- 00393
MONUMENTATION SURVEYS	None.
OBSERVATION WELLS	None.
WEIRS	None.
PIEZOMETERS	None.
OTHERS	

RESERVOIR AREA AND DOWNSTREAM CHANNEL

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA- 00393
SLOPES: RESERVOIR	Reservoir area and watershed steep and heavily wooded. No slope distress in evidence.
SEDIMENTATION	None apparent. Reservoir was dredged in 1964.
DOWNSTREAM CHANNEL (OBSTRUCTIONS, DEBRIS, ETC.)	Narrow, steep-sided valley to downstream residential area. Lower dam (1200 feet downstream) was breached during June, 1972 flood.
SLOPES: CHANNEL VALLEY	Channel slope is generally moderate from dam through residences. Valley slopes are steep upstream of residences and moderate to gentle downstream.
APPROXIMATE NUMBER OF HOMES AND POPULATION	At least 25 structures (homes, church, small businesses) line the downstream channel between the dam and Bald Eagle Creek. At least 100 persons could be affected by large flows associated with the failure of the facility.



UPPER CASTANEA DAM
GENERAL PLAN - FIELD INSPECTION NOTES


UPPER CASTANEA RESERVOIR DAM
PROFILE OF DAM CREST
FROM FIELD SURVEY
LEFT ABUTMENT
844
842
840
838
LOW TOP OF DAM @ TOP OF LEFT SPILLWAY WINGWALL, ELEV. 842.7
RIGHT ABUTMENT
TOP OF RIGHT SPILLWAY WINGWALL, ELEV. 843.0
SPILLWAY CREST, ELEV. 838.5
SCALE:
VERTICAL: 1 IN. = 4 FT
HORIZONTAL: 1 IN. = 50 FT

APPENDIX B

ENGINEERING DATA CHECKLIST

CHECK LIST
ENGINEERING DATA
PHASE I

NAME OF DAM Upper Castanea Reservoir Dam

ITEM	REMARKS NDI# PA- 00393
PERSONS INTERVIEWED AND TITLE	R. Marcinkevage - City Engineer (since mid-1976).
REGIONAL VICINITY MAP	See Figure 1, Appendix E.
CONSTRUCTION HISTORY	Excellent PennDER Reports from 1919 and 1927. Original dam constructed in 1869. Extensively renovated in 1927. Modifications to piping cira 1968. Modifications to downstream slope in 1979. Contract let for intake tower renovation in mid-1980.
AVAILABLE DRAWINGS	Two drawings from 1927 renovation available from PennDER and owner (see Figures 3 and 4). Two drawings for proposed 1980 rehabilitation available from owner (see Figures 5 and 6).
TYPICAL DAM SECTIONS	See Figure 3, Appendix E.
OUTLETS: PLAN DETAILS DISCHARGE RATINGS	See Figures 5 and 6, Appendix E. Discharge ratings not available.

CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)

ITEM	REMARKS NDI# PA- 00393
SPILLWAY: PLAN SECTION DETAILS	See Figures 3 and 4, Appendix E.
OPERATING EQUIP-MENT PLANS AND DETAILS	See Figures 5 and 6, Appendix E.
DESIGN REPORTS	None available.
GEOLOGY REPORTS	None available.
DESIGN COMPUTATIONS: HYDROLOGY AND HYDRAULICS STABILITY ANALYSES SEEPAGE ANALYSES	Spillway designed to pass approximately 1900 cfs which was considered ample in 1927. None available.
MATERIAL INVESTIGATIONS: BORING RECORDS LABORATORY TESTING FIELD TESTING	No formal records available; however, correspondence circa 1927 indicates test pits were excavated near dam. None available.

CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)

ITEM	REMARKS NDI# PA- 00393
BORROW SOURCES	Unknown, but probably from within reservoir area and/or adjacent slopes.
POST CONSTRUCTION DAM SURVEYS	None available. Reservoir surveyed during 1964 dredging work. Storage-elevation curves developed by owner.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	1927 study by Gannett, Seelye & Fleming - No formal report available.
HIGH POOL RECORDS	Lower Castanea Reservoir Dam (≃ 1200 feet downstream) was overtopped and breached in June 1972 flood. Upper dam did not overtop, but, a low spot in the crest was backfilled during the storm to prevent overtopping.
MONITORING SYSTEMS	None.
MODIFICATIONS	Extensive renovations in 1927 to spillway and dam. Some modifications to piping in 1968. Downstream slope regraded in 1979. Contract let for intake tower modification in 1980.

CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)

ITEM	REMARKS NDI# PA · 00393
PRIOR ACCIDENTS OR FAILURES	Original dam (1869) breached and repaired in 1889. Lower dam breached during flood of June 1972. Owner has good series of 8 x 10 photographs of breached dam. Breach trapezoidal shaped; approximately 50 percent of embankment failed.
MAINTENANCE: RECORDS MANUAL	No manual of formal records. Reservoir was drained and dredged in 1964. Sediment was dumped over left abutment which was regraded in 1979. Owner has series of 8 x 10 photographs of dredging work.
OPERATION: RECORDS MANUAL	None.
OPERATIONAL PROCEDURES	Presently self-regulating. All valves are closed except for the upstream inlet which is always open. Flow through supply line is controlled by pressure regulator located downstream of dam. Procedures will change upon 1980 renovation.
WARNING SYSTEM AND/OR COMMUNICATION FACILITIES	Owner has recently developed a general warning system for all their reservoirs and dams. Copy received by inspection team.
MISCELLANEOUS	A Flood Warning Committee monitors about 25 streams in the Lock Haven area. PennDER files contain 20 photographs from 1915 through 1928 which show reconstruction of old facility.

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CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

NDI ID # PA-00393
PENNDER ID # 18-7

SIZE OF DRAINAGE AREA: 2.77 square miles.

ELEVATION TOP NORMAL POOL: 838.5 STORAGE CAPACITY: 32.8 acre-feet.

ELEVATION TOP FLOOD CONTROL POOL: - STORAGE CAPACITY: -

ELEVATION MAXIMUM DESIGN POOL: - STORAGE CAPACITY: -

ELEVATION TOP DAM: 842.7 STORAGE CAPACITY: 43.0 acre-feet.

SPILLWAY DATA

CREST ELEVATION: 838.5 feet.

TYPE: Uncontrolled, rectangular, concrete chute.

CREST LENGTH: 54.0 feet

CHANNEL LENGTH: 112 feet (includes approach and discharge channels).

SPILLOVER LOCATION: Right abutment.

NUMBER AND TYPE OF GATES: None.

OUTLET WORKS

TYPE: Concrete tower with cast iron pipes and valves.

LOCATION: Within upstream slope near axis of dam.

ENTRANCE INVERTS: Approximately 823 feet.

EXIT INVERTS: Approximately 816 feet.

EMERGENCY DRAWDOWN FACILITIES: 12"ϕ and 18"ϕ blowoff lines.

HYDROMETEOROLOGICAL GAGES

TYPE: Rain gage.

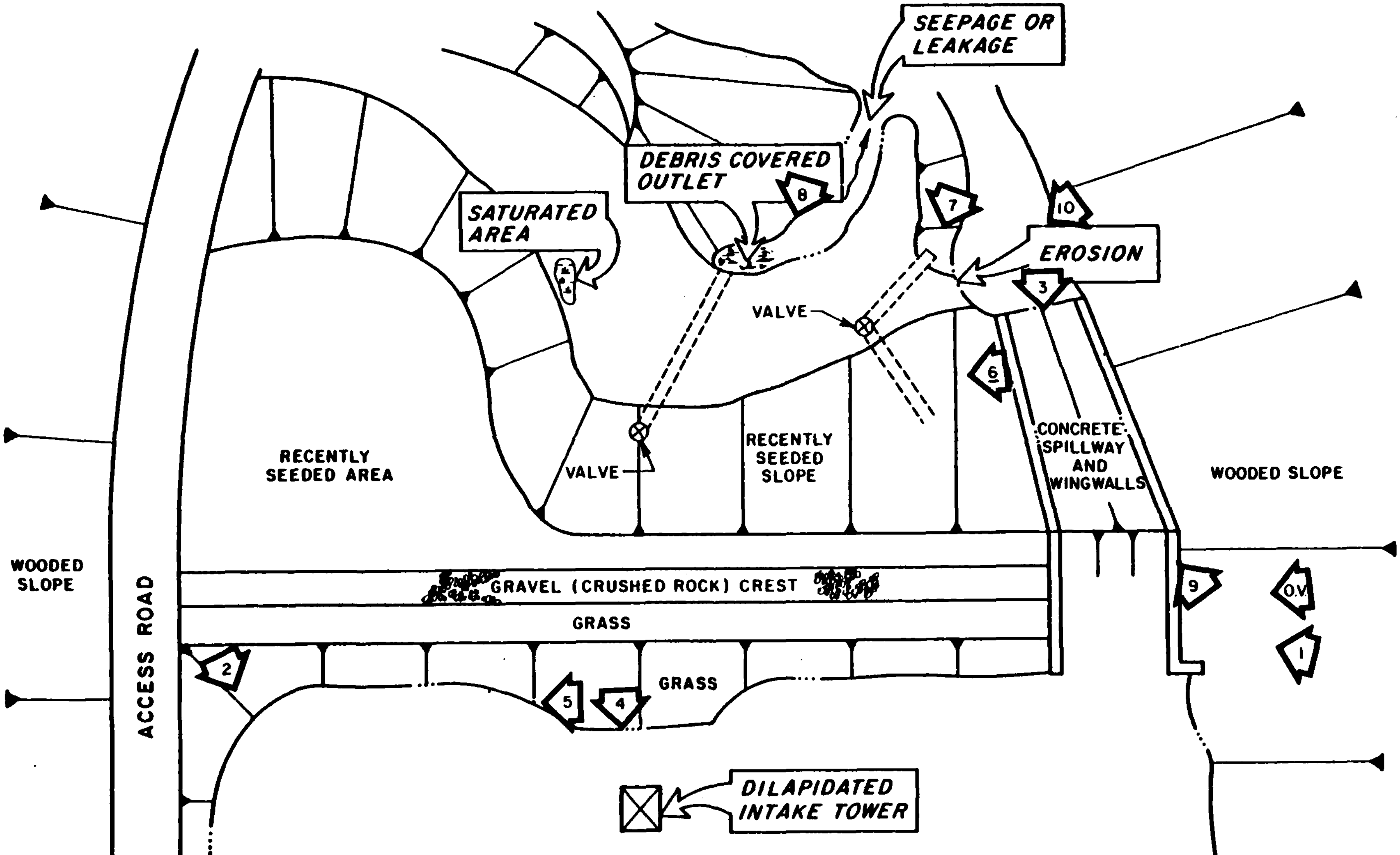
LOCATION: Sewage Treatment Plant in Lock Haven.

RECORDS: At treatment plant.

MAXIMUM NON-DAMAGING DISCHARGE: June 1972 (Lower dam breached).

APPENDIX C

PHOTOGRAPHS



UPPER CASTANEA DAM
PHOTOGRAPH KEY MAP

PHOTOGRAPH 1 View across the embankment crest as seen from the right abutment.

PHOTOGRAPH 2 View of the reservoir as seen from the embankment crest adjacent the left abutment.

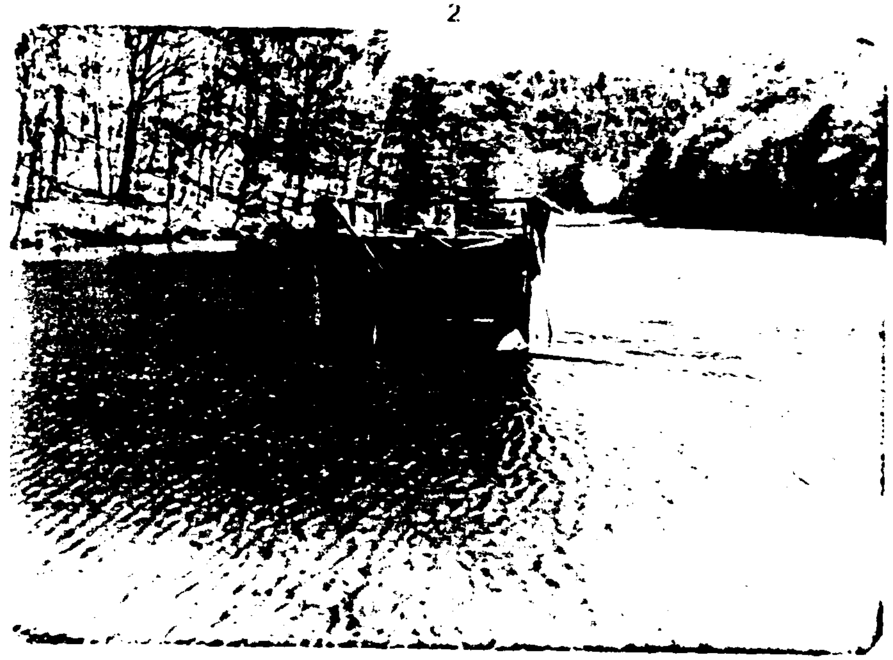
PHOTOGRAPH 3 View of the spillway looking upstream.

PHOTOGRAPH 4 View of the dilapidated intake tower as seen from the embankment crest.

1

2

3



4

PHOTOGRAPH 5	View of the upstream embankment face to the left of the intake tower looking toward the left abutment.
PHOTOGRAPH 6	View of the downstream embankment face as seen from the embankment crest adjacent the spillway.
PHOTOGRAPH 7	View of outlet to the 12-inch diameter blowoff conduit.
PHOTOGRAPH 8	View of debris covering outlet of the 18-inch diameter blowoff conduit; note seepage in channel downstream of outlet.

5

6

7

8

PHOTOGRAPH 9 View of the spillway and channel immediately downstream of the embankment.

PHOTOGRAPH 10 View of significant erosion occurring along the left side of the channel immediately beyond the spillway.

PHOTOGRAPH 11 View of downstream channel and nearby structures.

PHOTOGRAPH 12 View of downstream channel and nearby residences in the community of Castanea, Pennsylvania.


9


10


11


12

APPENDIX D

HYDROLOGY AND HYDRAULICS ANALYSES

PREFACE

The modified HEC-1 program is capable of performing two basic types of hydrologic analyses: 1) the evaluation of the overtopping potential of the dam; and 2) the estimation of the downstream hydrologic-hydraulic consequences resulting from assumed structural failures of the dam. Briefly, the computational procedures typically used in the dam overtopping analysis are as follows:

a. Development of an inflow hydrograph(s) to the reservoir.

b. Routing of the inflow hydrograph(s) through the reservoir to determine if the event(s) analyzed would overtop the dam.

c. Routing of the outflow hydrograph(s) from the reservoir to desired downstream locations. The results provide the peak discharge(s), time(s) of the peak discharge(s), and the maximum stage(s) of each routed hydrograph at the downstream end of each reach.

The evaluation of the hydrologic-hydraulic consequences resulting from an assumed structural failure (breach) of the dam is typically performed as shown below.

a. Development of an inflow hydrograph(s) to the reservoir.

b. Routing of the inflow hydrograph(s) through the reservoir.

c. Development of a failure hydrograph(s) based on specified breach criteria and normal reservoir outflow.

d. Routing of the failure hydrograph(s) to desired downstream locations. The results provide estimates of the peak discharge(s), time(s) to peak and maximum water surface elevations of failure hydrographs for each location.

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: UPPER CASTANEA RESERVOIR DAM

PROBABLE MAXIMUM PRECIPITATION (PMP) = 22.6 INCHES/24 HOURS [1]

STATION	1	2	3
STATION DESCRIPTION	HARVEY'S RUN SUB-BASIN	WEST KAMMERDINER RUN SUB-BASIN	LOCAL RESERVOIR SUB-BASIN
DRAINAGE AREA (SQUARE MILES)	0.78	1.93	0.06
CUMULATIVE DRAINAGE AREA (SQUARE MILES)	-	-	2.77
ADJUSTMENT OF PMF FOR DRAINAGE AREA LOCATION (%) [1]			
6 HOURS	117.5	117.5	117.5
12 HOURS	127.0	127.0	127.0
24 HOURS	136.0	136.0	136.0
48 HOURS	142.5	142.5	142.5
SNYDER HYDROGRAPH PARAMETERS			
ZONE (2)	20	20	20
C_p (3)	0.40	0.40	0.40
C_t (3)	2.10	2.10	2.10
L (MILES) (4)	1.7	2.6	N/A
L_{ca} (MILES) (4)	0.8	1.5	N/A
L' (MILES) (4)	N/A	N/A	0.3
t_p (MILES) (5)	2.30	3.16	1.02
SPILLWAY DATA			
CREST LENGTH (FEET)			54
FREEBOARD (FEET)			4.2

(1) HYDROMETEOROLOGICAL REPORT 40, U.S. WEATHER BUREAU, 1965.

(2) HYDROLOGIC ZONE DEFINED BY CORPS OF ENGINEERS, BALTIMORE DISTRICT, FOR DETERMINATION OF SNYDER COEFFICIENTS (C_p AND C_t).

(3) SNYDER COEFFICIENTS

(4) L = LENGTH OF LONGEST WATERCOURSE FROM DAM TO BASIN DIVIDE.
L_{ca} = LENGTH OF LONGEST WATERCOURSE FROM DAM TO POINT OPPOSITE BASIN CENTROID
L' = LENGTH OF LONGEST WATERCOURSE FROM RESERVOIR INLET TO DRAINAGE DIVIDE.

(5) $t_p = C_t\,(L \cdot L_{ca})^{0.3}$ or $t_p = C_t(L')^{0.6}$

SUBJECT DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM
BY WJV DATE 4-24-80 PROJ. NO. 79-203-393
CHKD. BY DDS DATE 5-2-80 SHEET NO. 1 OF 21

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DAM STATISTICS

- HEIGHT OF DAM ≈ 27 FT (FIELD MEASURED FROM INVERT OF 12-INCH Ø BLOWOFF OUTLET TO LOW TOP OF EMBANKMENT)

- NORMAL POOL STORAGE CAPACITY ≈ 32.9 AC-FT (SEE NOTE 1)

- MAXIMUM POOL STORAGE CAPACITY ≈ 43.0 AC-FT (SHEET 6) (@ LOW TOP OF DAM)

- DRAINAGE AREA: HARVEYS RUN BASIN ≈ 0.79 SQ.MI.
  WEST KAMMERDINER RUN BASIN ≈ 1.93 SQ.MI. (SEE NOTE 1)
  LOCAL RESERVOIR BASIN ≈ 0.06 SQ.MI.
  TOTAL DRAINAGE AREA ≈ 2.77 SQ.MI.

- ELEVATION OF LOW TOP OF DAM ≈ 842.7 (FIELD)
  843.0 (DESIGN, FIGURE 3)

- NORMAL POOL ELEVATION ≈ 839.5 (FIGURE 4)
  (ALSO SPILLWAY CREST ELEVATION)

- UPSTREAM INLET INVERT ELEVATIONS:
  12 INCH Ø BLOWOFF ⇒ 822 ± FT (ESTIMATED)
  13 INCH Ø BLOWOFF ⇒ 822.7 FT (FIGURE 2)
  10 INCH Ø SUPPLY LINE ⇒ 824.6 FT (FIGURE 3)

- DOWNSTREAM OUTLET INVERT ELEVATIONS:
  12 INCH Ø BLOWOFF ⇒ 816 FT (FIELD MEASUREMENT
  13 INCH Ø BLOWOFF ⇒ 816 FT (FIELD ESTIMATE

UBJECT DAM SAFETY INSPECTION

UPPER CASTANEA RESERVOIR DAM

BY WJV DATE 4-24-80 PROJ. NO. 79-203-393

CHKD. BY DJS DATE 5-2-80 SHEET NO. 2 OF 21

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10 INCH SUPPLY LINE ⇒ N/A
(SUPPLY SYSTEM)

- STREAMBED AT DAM CENTERLINE ≈ 919 (ESTIMATE)

NOTE 1: NORMAL POOL STORAGE VALUE OBTAINED FROM "REPORT UPON THE APPLICATION OF THE CITY OF LOCK HAVEN FOR ALTERATIONS TO THE UPPER HARVEYS RUN DAM ON HARVEYS RUN, CASTANEA TOWNSHIP, CLINTON COUNTY PENNSYLVANIA", AS FOUND IN PENNDER FILES. ACTUAL REPORTED VALUE WAS 10.7 MG. DRAINAGE AREA: PLANIMETERED ON THE USGS 7.5 MINUTE TOPOGRAPHIC QUADS: MILL HALL, LOCK HAVEN, LOGANTON, AND JERSEY SHORE, PA.

DAM CLASSIFICATION

DAM SIZE - SMALL (REF 1, TABLE 1)

HAZARD CLASSIFICATION - HIGH (FIELD OBSERVATION)

REQUIRED SDF : ½ PMF TO PMF (REF 1, TABLE 3)

HYDROGRAPH PARAMETERS

	HARVEYS RUN BASIN	WEST KAMMERDINER RUN BASIN	LOCAL RESERVOIR BASIN
- LENGTH OF LONGEST WATERCOURSE (L):	1.7 MI	2.6 MI	N/A
- LENGTH ALONG LONGEST WATERCOURSE TO A POINT OPPOSITE THE CENTROID OF THE BASIN (Lca):	0.9 MI	1.5 MI	N/A

SUBJECT DAM SAFETY INSPECTION

UPPER CASTANEA RESERVOIR DAM

BY WJV DATE 4-24-80 PROJ. NO. 79-203-393

CHKD. BY DJS DATE 5-2-80 SHEET NO. 3 OF 21

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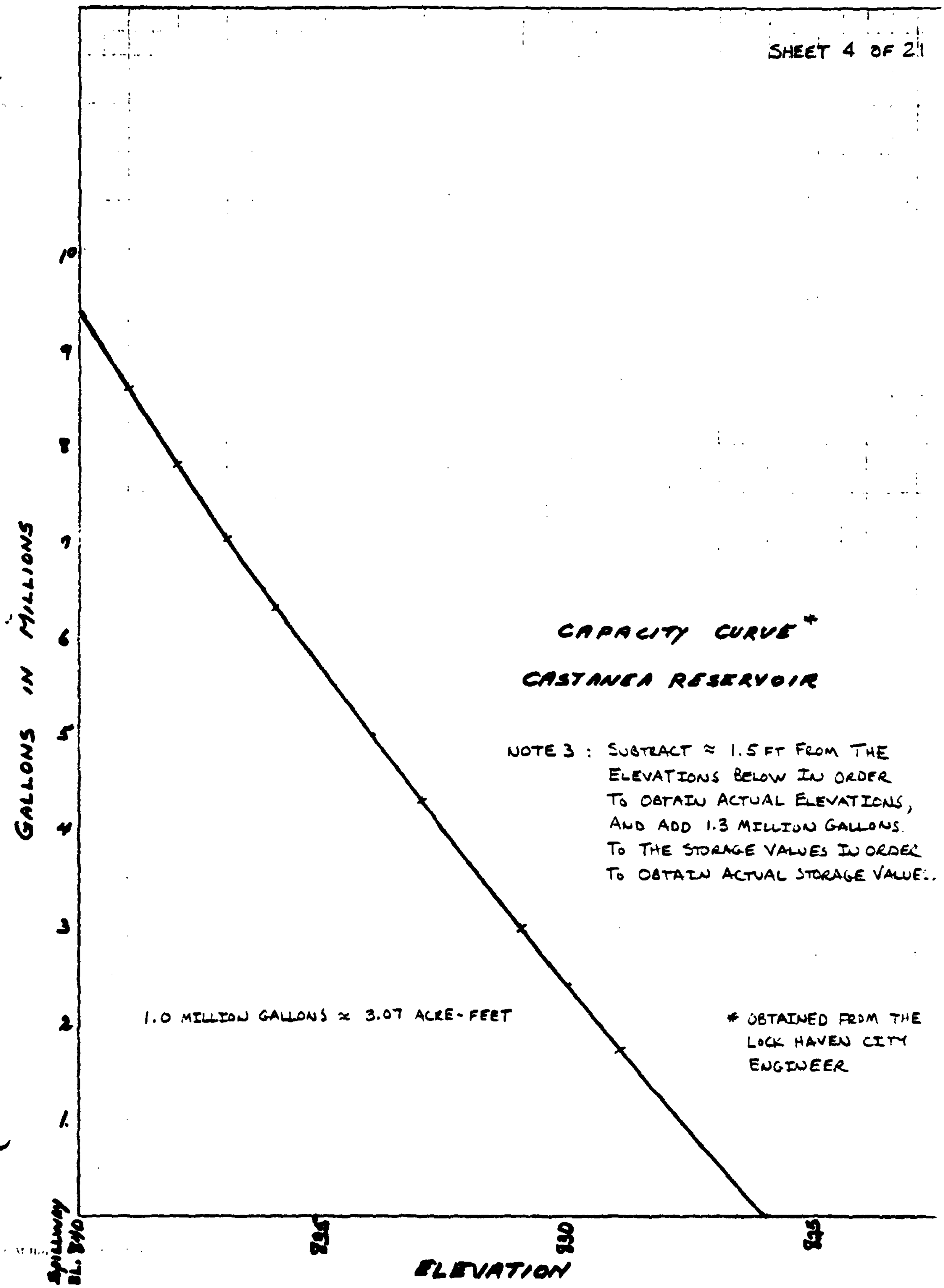
		HARVEYS RUN BASIN	WEST KAMMERLINER RUN BASIN	LOCAL RESERVOIR BASIN
- LENGTH OF LONGEST WATERCOURSE FROM RESERVOIR INLET TO DRAINAGE DIVIDE (L'):		N/A	N/A	0.3 MI
ZONE 20, SUSQUEHANNA RIVER BASIN	C_t :	2.10	2.10	2.10
	C_p :	0.40	0.40	0.40
- SNYDERS STANDARD LAG: $t_p \approx C_t (L \times L_{CA})^{0.3}$	:	2.30 HR	3.16 HR	N/A
$t_p \approx C_t (L')^{0.6}$	:	N/A	N/A	1.02 HR

NOTE 2: HYDROGRAPH VARIABLES USED HERE ARE DEFINED IN REF. 2, IN THE SECTION ENTITLED "SNYDER SYNTHETIC UNIT HYDROGRAPH". THE t_p-VALUE FOR THE LOCAL RESERVOIR BASIN WAS COMPUTED DIFFERENTLY SINCE THE BASIN CENTROID WAS LOCATED WITHIN THE RESERVOIR (AS PER COE DIRECTIVE). C_t AND C_p VALUES SUPPLIED BY COE

RESERVOIR STORAGE CAPACITY

- STORAGE CAPACITY @ NORMAL POOL EL 939.5 ≈ 32.9 AC-FT (SHEET 1

- STORAGE VALUES FOR ELEVATIONS LOWER THAN 939.5 CAN BE OBTAINED FROM THE CAPACITY CURVE PROVIDED ON SHEET 4. APPROXIMATELY 1.5 FT MUST BE SUBTRACTED FROM THE ELEVATIONS GIVEN ON SHEET 7 IN ORDER TO CORRECT THEM TO ACTUAL. ALSO, AN ADDITIONAL 1.3 MILLION GALLONS OF STORAGE IS PROVIDED BELOW THE CITY DRAW-OFF LINE INVERT ELEVATION OF ≈ 924.6 (THE "0" STORAGE ELEVATION ON SHEET 7) ACCORDING TO INFORMAT- PROVIDED BY THE LOCK HAVEN CITY ENGINEER. THEREFORE, 1.3 MILLION GALLONS MUST BE ADDED TO ALL THE STORAGE VALUES ON SHEET 7, WIT-


CAPACITY CURVE*
CASTANEA RESERVOIR
NOTE 3 : SUBTRACT ≈ 1.5 FT FROM THE ELEVATIONS BELOW IN ORDER TO OBTAIN ACTUAL ELEVATIONS, AND ADD 1.3 MILLION GALLONS TO THE STORAGE VALUES IN ORDER TO OBTAIN ACTUAL STORAGE VALUES.
1.0 MILLION GALLONS ≈ 3.07 ACRE-FEET
* OBTAINED FROM THE LOCK HAVEN CITY ENGINEER
GALLONS IN MILLIONS
1
2
3
4
5
6
7
8
9
10
ELEVATION
SPILLWAY EL. 840
835
830
825

"O" STORAGE @ THE ESTIMATED ELEVATION OF 822.0 FT

- RESERVOIR SURFACE AREA (SA) @ NORMAL POOL EL 838.5 ≈ 2.2 AC

SA @ EL 860 ≈ 4.7 AC

[SA VALUES PLANIMETERED ON THE USGS 7.5 MINUTE MILL HALL, PA QUAD]

∴ RATE OF SURFACE AREA INCREASE PER FOOT OF RESERVOIR RISE (FOR ELEVATIONS ABOVE 838.5 FT) ≈ $(4.7-2.2)\text{AC}/(860-838.5)\text{FT}$

≈ 0.12 AC/FT

- FOR ELEVATIONS ABOVE 838.5 FT, RESERVOIR STORAGE VALUES CAN BE APPROXIMATED VIA THE MODIFIED PRISMOIDAL RELATIONSHIP:

$$\Delta V_{1-2} = h/3 \left(A_1 + A_2 + \sqrt{A_1 \times A_2}\right)$$ (REF 14, PG 15)

WHERE ΔV_{1-2} = INCREMENTAL VOLUME BETWEEN ELEVATIONS 1 AND 2, IN AC-FT;

h = ELEVATION 2 - ELEVATION 1, IN FT; AND

A_1, A_2 = SURFACE AREAS @ ELEVATIONS 1 AND 2, RESPECTIVELY, IN AC.

ALSO, RESERVOIR SURFACE AREAS FOR ELEVATIONS ABOVE 838.5 FT CAN BE APPROXIMATED BY THE RELATIONSHIP:

$$A_i = A_{\text{NORMAL POOL}} + \left[0.12\ \text{AC/FT}\left(\text{ELEVATION}_i - \text{ELEVATION}_{\text{NORMAL POOL}}\right)\right]$$

$$\therefore\ A_i \approx 2.2\ \text{AC} + \left[0.12\ \text{AC/FT}\left(\text{ELEVATION}_i - 838.5\ \text{FT}\right)\right]$$

SUBJECT DAM SAFETY INSPECTION

UPPER CASTANEA RESERVOIR DAM

BY WJV DATE 4-25-80 PROJ. NO. 79-203-392

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- RESERVOIR STORAGE VS ELEVATION RELATIONSHIP :

	ELEVATION (FT)	h (FT)	A_i (AC)	ΔV_{1-2} (AC-FT)	TOTAL STORAGE SHEET 4 (AC-FT)	TOTAL STORAGE $\Sigma(\Delta V_{1-2})$ (AC-FT)
	822.0	-	-	-	0.0	-
	824.6	-	-	-	4.0	-
	827.5	-	-	-	9.3	-
	829.5	-	-	-	13.1	-
	831.5	-	-	-	17.2	-
	834.5	-	-	-	23.3	-
	835.5	-	-	-	25.5	-
	836.5	-	-	-	27.9	-
	837.5	-	-	-	30.3	-
	838.5	-	2.2	-	32.8	32.8
	839.0	0.5	2.3	1.1	-	33.9
	840.0	1.0	2.4	2.3	-	36.2
	841.0	1.0	2.5	2.4	-	38.6
	842.0	1.0	2.6	2.5	-	41.1
LOW TOP OF DAM -	842.7	0.7	2.7	1.9	-	43.0
	843.0	0.3	2.7	0.8	-	43.8
	844.0	1.0	2.9	2.8	-	46.6
	845.0	1.0	3.0	2.9	-	49.5
	846.0	1.0	3.1	3.0	-	52.5
	847.0	1.0	3.2	3.1	-	55.6

SUBJECT DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM

BY WJV DATE 4-25-80 PROJ. NO. 79-203-393

CHKD. BY DJS DATE 5-2-80 SHEET NO. 7 OF 21

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PMP CALCULATIONS

- STANDARD RAINFALL INDEX = 22.2 IN (REF 9, FIG 2)
  (CORRESPONDING TO A DURATION OF 24 HR AND AN AREA OF 200 SQ MI.)

- GEOGRAPHIC ADJUSTMENT FACTOR = 102 % (REF 9, FIG 1)
  (CORRESPONDING TO A LONGITUDE OF 77° 25', AND A LATITUDE OF 41° 07')

- CORRECTED RAINFALL INDEX ≈ (22.2 IN)(1.02) ≈ 22.6 IN

- THE PMP STORM WILL BE CENTERED OVER THE TOTAL 2.77 SQ MI DRAINAGE AREA ABOVE THE DAM. SINCE THE TOTAL AREA IS < 10 SQ MI, THE THREE INDIVIDUAL SUBAREAS ARE < 10 SQ MI, AND EACH OF THE SUBAREAS WILL HAVE THE SAME RAINFALL INDEX (22.6 IN) AND RAINFALL DISTRIBUTION:

DURATION (HR)	PERCENT OF INDEX RAINFALL (%)
6	117.5
12	127.0
24	136.0
48	142.5

NOTE 4: A 48-HR RATHER THAN A 72-HR STORM DURATION IS USED IN THE ANALYSIS DUE TO DIMENSIONAL CONSTRAINTS IMPOSED BY THE HEC-1 MODEL

- HOP BROOK FACTOR (ADJUSTMENT FOR BASIN SHAPE AS WELL AS FOR THE LESSER LIKELIHOOD OF A SEVERE STORM CENTERING OVER A SMALLER BASIN) CORRESPONDING TO DA < 10 SQ MI ⇒ 0.80 (REF 4, PG 48)

SUBJECT DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM

BY WJV DATE 4-25-80 PROJ. NO. 79-203-393

CHKD. BY DJJ DATE 5-2-80 SHEET NO. 3 OF 21

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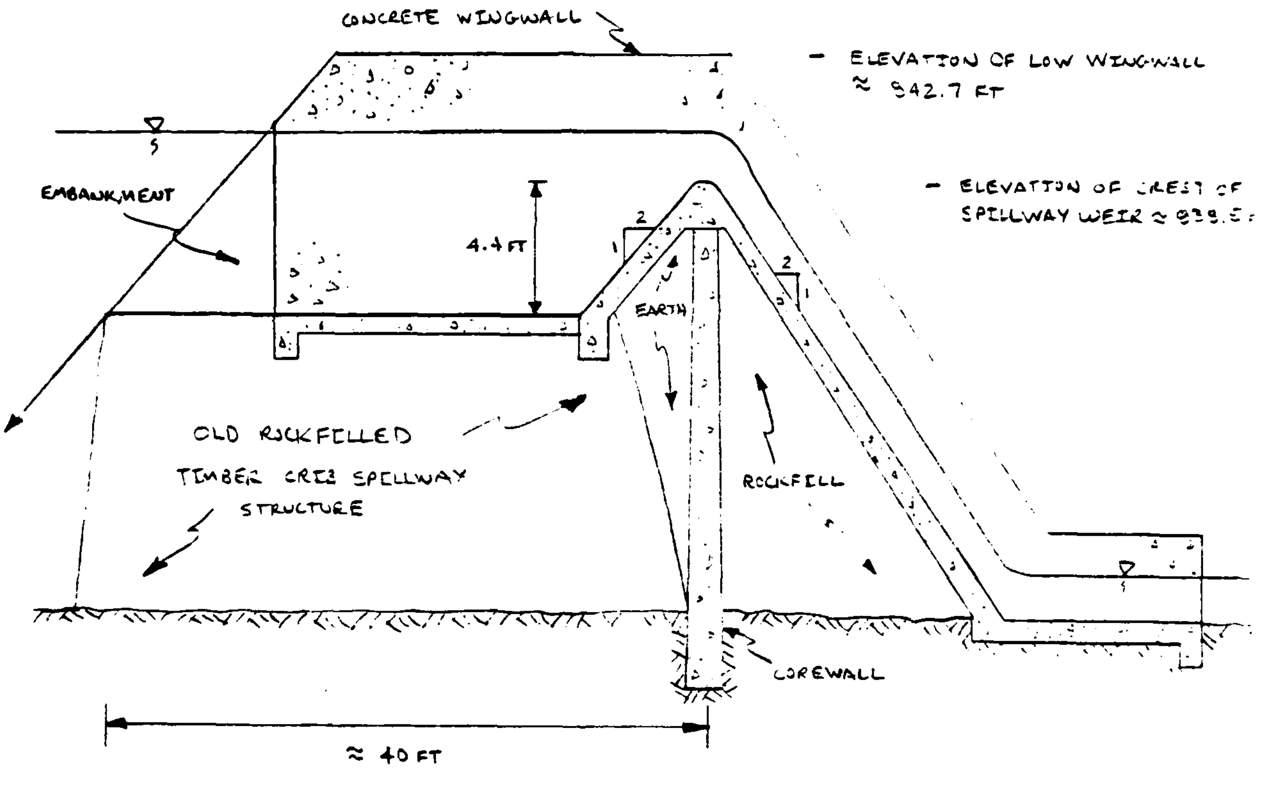
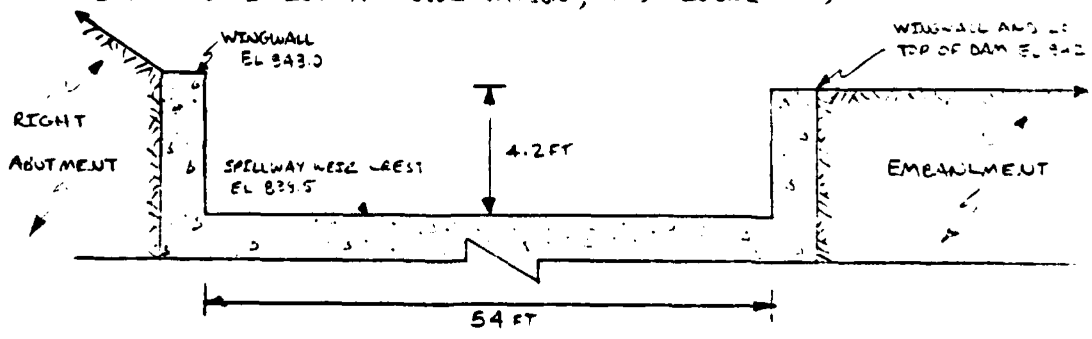
SPILLWAY CAPACITY

- PROFILE OF SPILLWAY : (NOT TO SCALE)
(FROM FIELD MEASUREMENT AND OBSERVATION; AND FIGURE 4)



- CROSS-SECTION OF SPILLWAY : (NOT TO SCALE)
(FROM FIELD MEASUREMENT AND OBSERVATION, AND FIGURE 4)



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- THE DAM IS SERVED BY A FREE OVERFALL, RECTANGULAR, CHUTE CHANNEL SPILLWAY, WITH DISCHARGES CONTROLLED BY A ROUND-CRESTED, TRIANGULAR SHAPED WEIR STRUCTURE. WEIR FLOWS CAN BE ESTIMATED FROM THE EQUATION:

$$Q = CLH^{3/2}$$ (REF 5, PG 5-3)

WHERE Q = DISCHARGE OVER WEIR, IN CFS;
L = LENGTH OF WEIR ≈ 54 FT;
H = RESERVOIR ELEVATION - 939.5 FT; AND
C = DISCHARGE COEFFICIENT, ASSUMED TO EQUAL 3.75 FOR H ≈ 4.2 FT (REF 5, PG. 5-42 AND 5-43)

- APPROACH CHANNEL LOSSES: ENTRANCE LOSS AND FRICTION LO..

FOREBAY DEPTH ≈ 4.4 FT ; MAXIMUM WEIR HEAD ≈ 4.2 FT
CHANNEL WIDTH ≈ 54 FT
CHANNEL LENGTH ≈ 40 FT
RT CHANNEL SIDEWALL COMPOSED OF CONCRETE WINGWALL IN ABUTMENT
⇒ VERTICAL SIDESLOPE AND AVERAGE HEIGHT ≈ 4.4 FT + 4.2 FT ≈ 8
LT CHANNEL SIDEWALL COMPOSED OF CONCRETE WINGWALL ABUTTING EMBANKMENT ⇒ VERTICAL SIDESLOPE AND AVERAGE HEIGHT
$\approx [(25\,FT \times 8.6\,FT) + (15\,FT \times \frac{8.6\,FT}{2})] / 40\,FT \approx 7.0\,FT$

a) MAXIMUM APPROACH DEPTH ≈ 8.6 FT (FOREBAY + WEIR HEAD)
MAXIMUM FLOW AREA ≈ 8.6 FT × 54 FT ≈ 464.4 FT^2

INITIAL DISCHARGE ESTIMATE ≈ $CLH^{3/2}$ ≈ (3.75)(54 FT)(4.2 FT$)^{3/2}$
≈ 1743 CFS

⇒ APPROACH CHANNEL VELOCITY ≈ 1743 CFS / 464.4 FT^2 ≈ 3.8 FPS

APPROACH VELOCITY HEAD ≈ $(3.8\,FPS)^2 / 2g$ ≈ 0.2 FT = h_a

$\therefore$ ENTRANCE LOSS $\approx 0.1\ h_a \approx 0.02$ FT (REF 4, PG 379)

b) FRICTION LOSS $\approx (v_a n / 1.49 R^{2/3}) \times L_c = h_f$

WHERE v_a = APPROACH CHANNEL VELOCITY $\approx$ 3.9 FPS,
n = APPROACH CHANNEL ROUGHNESS $\approx$ 0.02
(FROM EXPERIENCE $\Rightarrow$ CHANNEL PARTIALLY CONCRETE AND PARTIALLY ROCK W/ LOOSE ROCK COVERING),
R = HYDRAULIC RADIUS = FLOW AREA / WETTED PERIMETER
$\approx 464.4\ FT^2 / [7.0\ FT + 54\ FT + 8.6\ FT] \approx 6.7$ FT, AND
L_c = APPROACH CHANNEL LENGTH $\approx$ 40 FT

$$\therefore h_f \approx \left[(3.9\ FPS)(0.02) / 1.49\ (6.7)^{2/3} \right]^2 \times (40\ FT)$$
$$\approx 0.01\ FT$$

$\Rightarrow$ TOTAL LOSSES $\approx$ 0.02 FT + 0.01 FT $\approx$ 0.03 FT

$\Rightarrow$ IGNORE APPROACH LOSSES

$\therefore$ SPILLWAY DISCHARGE CAPACITY $\approx CLH^{3/2}$
$\approx (3.75)(54\ FT)(4.2\ FT)^{3/2}$
$\approx$ 1740 CFS

SPILLWAY RATING CURVE

AS THE HEAD ABOVE THE WEIR BECOMES SMALL, THE ROUGHNESS OF THE CREST AND THE CONTACT PRESSURE BETWEEN THE WATER AND THE CREST EXERT A LARGER INFLUENCE ON DISCHARGES. THAT IS, THE C-VALUES DECREASE WITH DECREASING HEAD. THE OPPOSITE

SUBJECT	DAM SAFETY INSPECTION
	UPPER CASTANEA RESERVOIR DAM
BY WJV	DATE 4-23-80	PROJ. NO. 79-203-393
CHKD. BY DJS	DATE 5-2-80	SHEET NO. 11 OF 21

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TREND OCCURS FOR HIGHER HEADS. THEREFORE, ASSUME THAT THE DISCHARGE COEFFICIENT - HEAD RELATIONSHIP FOR AN OGEE-CRESTED WEIR (REF 4, PG 378, FIG 250) CAN REPRESENT THE ACTUAL DISCHARGE COEFFICIENT - HEAD RELATIONSHIP FOR THE ROUND-CRESTED WEIR BEING CONSIDERED HERE. THE MAXIMUM HEAD PRIOR TO EMBANKMENT OVERTOPPING, 4.2 FT, WILL BE ASSUMED TO BE THE DESIGN HEAD (H_o). THE DESIGN DISCHARGE COEFFICIENT (C_o) WILL BE ASSUMED TO BE 3.75.

ALL DISCHARGES OVER THE WEIR ARE DEFINED BY THE $Q = CLH^{3/2}$ RELATIONSHIP, WITH APPROACH LOSSES ASSUMED TO BE NEGLIGIBLE.

ELEVATION (FT)	① H (FT)	H/H_o (FT/FT)	② C/C_o	③ C	④ Q (CFS)
938.5	0	-	-	-	0
939.5	1.0	0.2	0.85	3.19	170
940.5	2.0	0.5	0.92	3.45	530
941.5	3.0	0.7	0.96	3.60	1010
942.5	4.0	1.0	1.0	3.75	1620
942.7	4.2	1.0	1.0	3.75	1740
943.0	4.5	1.1	1.01	3.79	1950
944.0	5.5	1.3	1.04	3.90	2720
945.0	6.5	1.5	1.06	3.98	3560
946.0	7.5	1.8	1.07	4.01	4450

① H = RESERVOIR ELEVATION - 938.5 FT;
② REF 4, PG 378, FIG 250, BASED ON H/H_o VALUE;
③ $C = (C/C_o) \times 3.75$
④ $Q = CLH^{3/2} \approx 54\, CH^{3/2}$

SUBJECT	DAM SAFETY INSPECTION		
	UPPER CASTANEA RESERVOIR DAM		
BY WJV	DATE 4-29-80	PROJ. NO. 79-203-393	
CHKD. BY DJS	DATE 5-2-80	SHEET NO. 12 OF 21	

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EMBANKMENT RATING CURVE

- LENGTH OF EMBANKMENT SUBMERGED VS RESERVOIR ELEVATION (BASED ON FIELD MEASUREMENTS):

EMBANKMENT LENGTH (FT)	RESERVOIR ELEVATION (FT)
0	942.7
100	942.9
150	943.1
200	943.5
220	945.7

- ASSUME THAT DISCHARGES OVER THE EMBANKMENT ARE CONTROLLED BY CRITICAL DEPTH ON THE CREST. THE EMBANKMENT CREST VARIES IN BREADTH FROM 23 FT @ THE SPILLWAY WINGWALL TO ABOUT 150 FT NEAR THE LEFT ABUTMENT. THE WIDER CREST SECTION SLOPES @ APPROXIMATELY 4.0%, WHILE THE NARROWER SECTION IS RELATIVELY FLAT BUT DROPS OFF AT A 3H TO 1V SLOPE AT ITS DOWNSTREAM END. SINCE THE TOP WIDTH OF WATER FLOWING OVER THE CREST WILL APPROXIMATELY BE THE SAME AS THE LENGTH OF CREST INUNDATED, THE RELATIONSHIP BETWEEN THE HEIGHT OF RESERVOIR WATER SURFACE ABOVE THE CREST LEVEL AND THE CRITICAL DEPTH ON THE CREST IS:

$$Y_R \approx \tfrac{3}{2}\, Y_c \qquad \text{(REF 13, PG 143)}$$

ALSO, CRITICAL FLOW IS DEFINED BY:

$$Q^2 \approx g\, A_c^3 / B_c \qquad \text{(REF 13, PG 141)}$$

SUBJECT DAM SAFETY INSPECTION
UPPER CASTENEA RESERVOIR DAM

BY WJV DATE 4-29-80 PROJ. NO. 79-203-393
CHKD. BY DJS DATE 5-2-80 SHEET NO. 13 OF 21

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WHERE Y_R = RESERVOIR ELEVATION - 842.7 FT (MINIMUM CREST ELEVATION);
Y_c = CRITICAL DEPTH OF FLOW OVER CREST, IN FT;
Q = CRITICAL DISCHARGE, IN CFS;
A_c = CRITICAL FLOW AREA ≈ 1/2 $Y_c L_E$, IN FT;
L_E = LENGTH OF EMBANKMENT INUNDATED BY CRITICAL FLOW (FROM SHEET 12), IN FT, AND
B_c = TOP WIDTH OF CRITICAL FLOW AREA ≈ L_E, IN FT.

RESERVOIR ELEVATION (FT)	Y_R (FT)	Y_c (FT)	$L_E \approx B_c$ (FT)	A_c (FT^2)	Q (CFS)
842.7	0	–	–	–	0
842.9	0.2	0.13	65	4.2	10
843.1	0.4	0.27	118	15.9	30
843.5	0.8	0.53	166	44.0	130
845.7	3.0	2.00	211	211	1200

- CHECK FOR CRITICAL FLOW SLOPE VIA MANNING'S EQUATION:

$$S_c = \left(n\,Q / 1.49\, A_c R_c^{2/3} \right)^2$$ (REF. 3, PG 142)

w/ $n \approx 0.04$ (HIGH GRASS COVER, REF 7, PG); $A_c \approx 211$ FT^2;
$R_c \approx$ FLOW AREA/WETTED PERIMETER $\approx A_c/B_c \approx$ 211 FT^2/211 FT $\approx$ 1.0;
AND $Q \approx 1200$ CFS.

$\therefore\ S_c \approx 0.023 < S_{ACTUAL} \approx 0.044$

∴ CRITICAL FLOW DOES CONTROL DISCHARGE

SUBJECT DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM

BY WJV DATE 4-29-80 PROJ. NO. 79-203-393
CHKD. BY DJS DATE 5-2-80 SHEET NO. 14 OF 21

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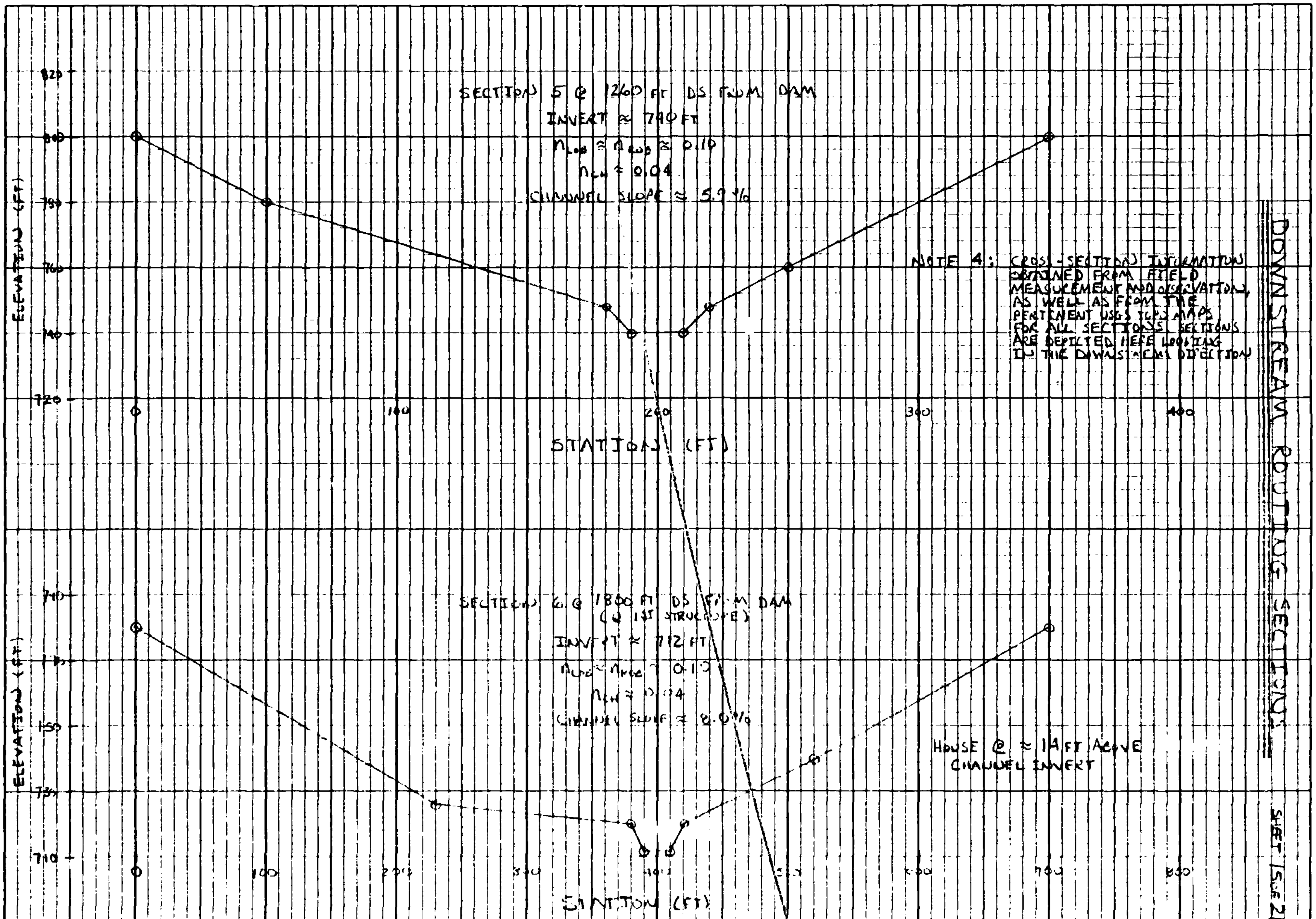
TOTAL FACILITY RATING CURVE

TOTAL FACILITY DISCHARGE = $Q_{SPILLWAY} + Q_{EMBANKMENT}$

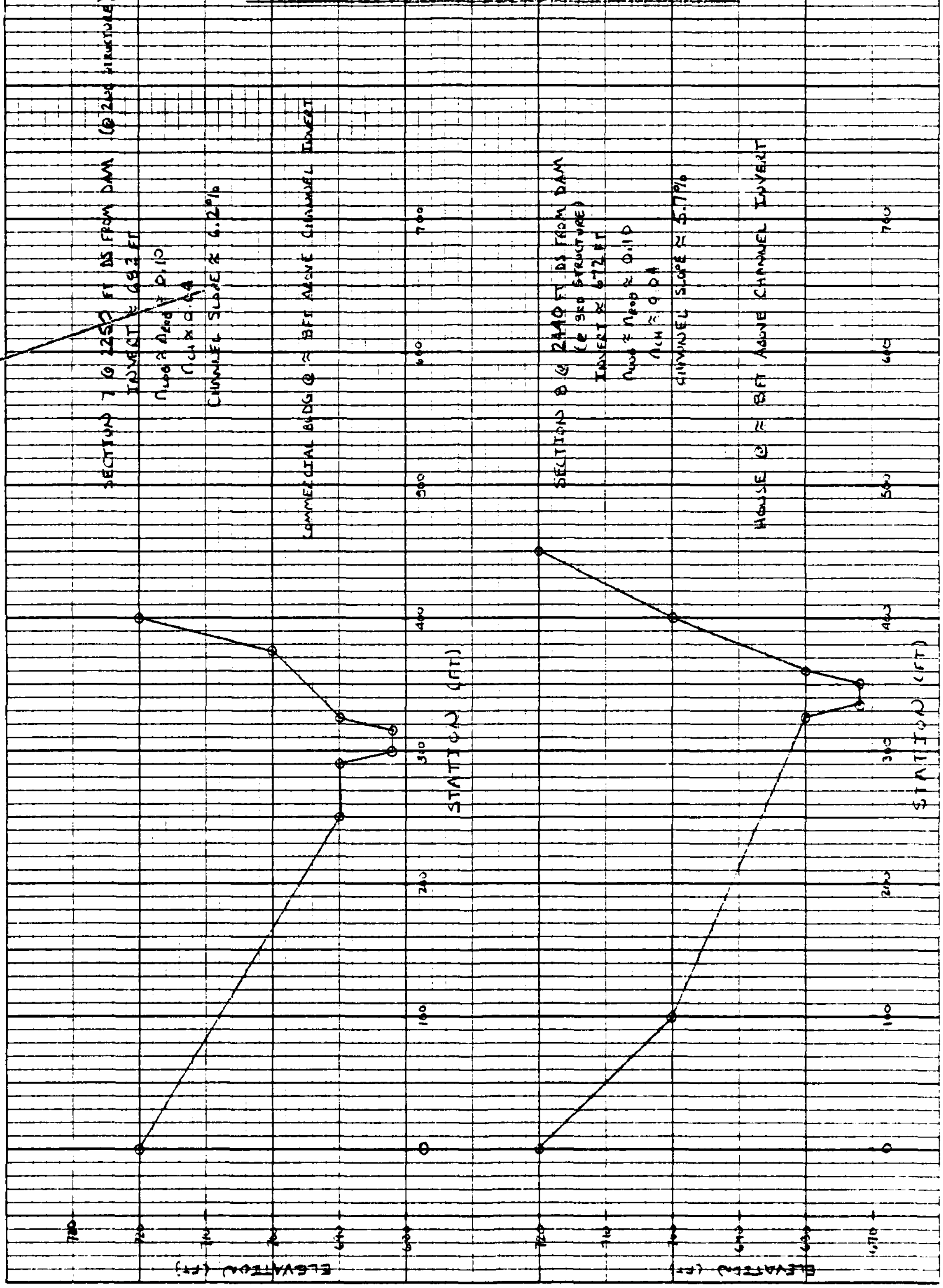
	RESERVOIR ELEVATION (FT)	① SPILLWAY Q (CFS)	② EMBANKMENT Q (CFS)	TOTAL Q (CFS)
	838.5	0	-	0
	839.5	170	-	170
	840.5	530	-	530
	841.5	1010	-	1010
	842.5	1620	-	1620
(LOW TOP OF DAM)	842.7	1740	0	1740
	842.9	*1880	10	1890
	843.1	*2030	30	2060
	843.5	*2340	130	2470
	844.0	2720	+300	3020
	845.0	3560	+760	4320
	845.7	*4180	1200	5380

* STRAIGHT-LINE INTERPOLATION ; + LOG-LOG INTERPOLATION

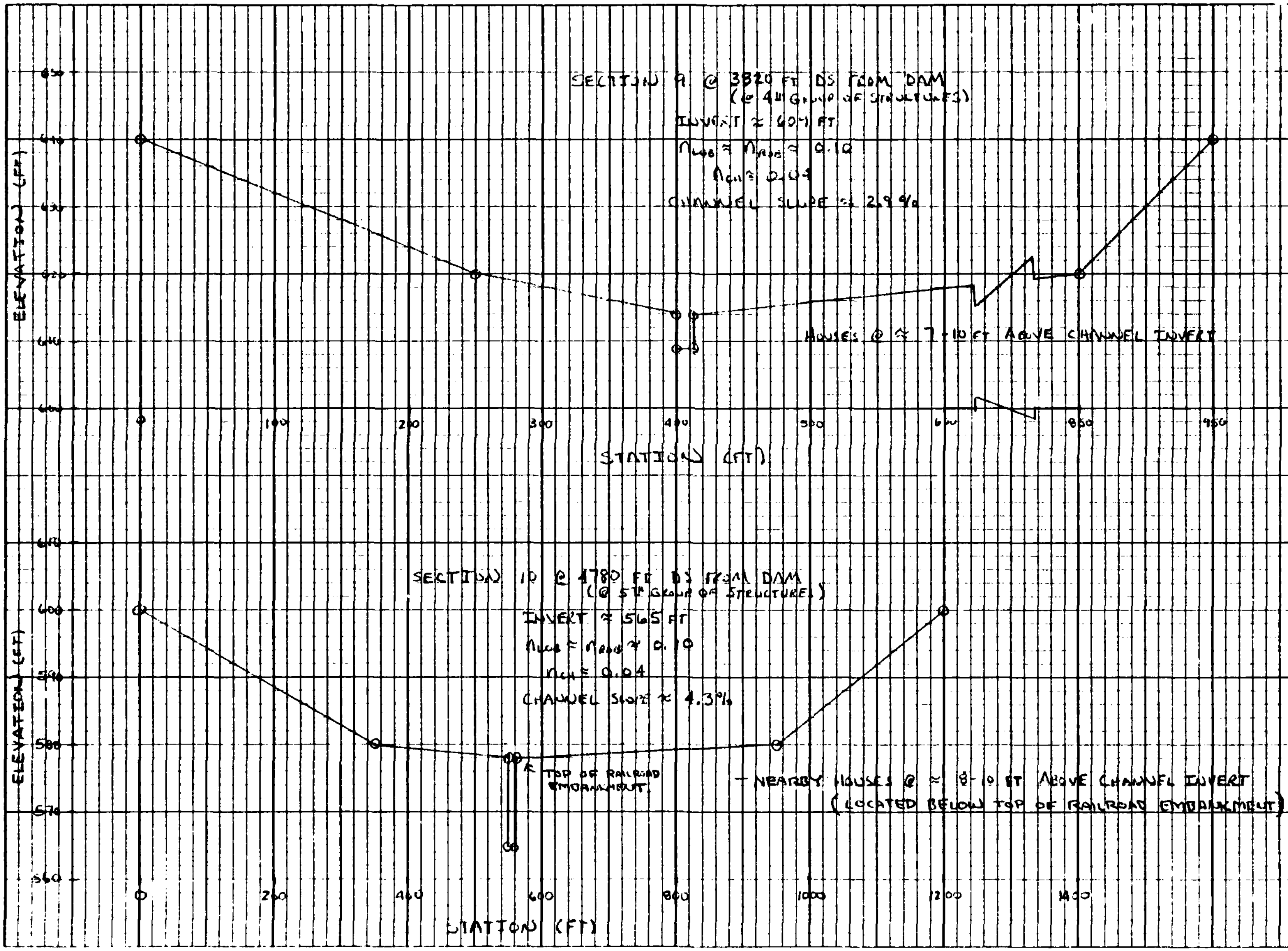
① FROM SHEET 11
② FROM SHEET 13


DOWNSTREAM ROUTING SECTIONS
SHEET [5 OF 2]
SECTION 5 @ 1260 FT DS FROM DAM
INVERT ≈ 740 FT
$n_{LOB} \approx n_{ROB} \approx 0.10$
$n_{CH} \approx 0.04$
CHANNEL SLOPE ≈ 5.9 %
NOTE 4: CROSS-SECTION INFORMATION OBTAINED FROM FIELD MEASUREMENT AND OBSERVATION, AS WELL AS FROM THE PERTINENT USGS TOPO MAPS. FOR ALL SECTIONS, SECTIONS ARE DEPICTED HERE LOOKING IN THE DOWNSTREAM DIRECTION
ELEVATION (FT)
STATION (FT)
SECTION 6 @ 1800 FT DS FROM DAM
(@ 1ST STRUCTURE)
INVERT ≈ 712 FT
$n_{LOB} \approx n_{ROB} \approx 0.10$
$n_{CH} \approx 0.04$
CHANNEL SLOPE ≈ 8.0 %
HOUSE @ ≈ 14 FT ABOVE CHANNEL INVERT
ELEVATION (FT)
STATION (FT)

DOWNSTREAM ROUTING SECTIONS



DOWNSTREAM ROUTING SECTIONS



SUBJECT DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM

BY WJV DATE 6-3-80 PROJ. NO. 79-203-393

CHKD. BY DJS DATE 6-3-80 SHEET NO. 18 OF 21

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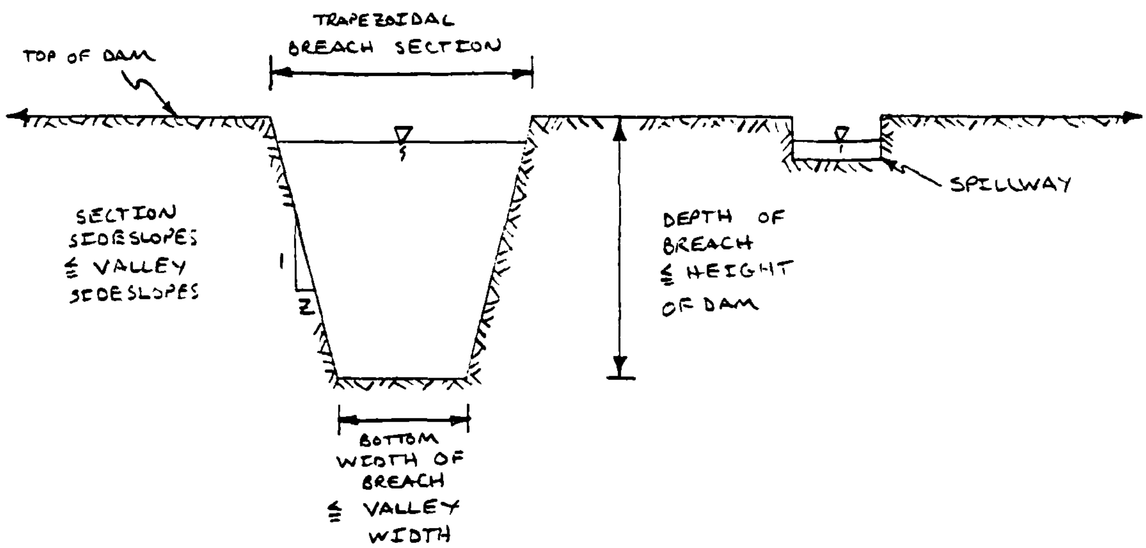
BREACH ASSUMPTIONS

- TYPICAL BREACH SECTION:



- HEC-1 BREACHING ANALYSIS INPUTS:

(BREACHING WILL COMMENCE WHEN THE RESERVOIR LEVEL REACHES THE TOP OF DAM ELEVATION)

PLAN NUMBER AND COMMENT	BREACH BOTTOM WIDTH (FT)	MAX BREACH DEPTH (FT)	SECTION SIDESLOPES	BREACH TIME* (HR)	W.EL. @ TOP OF FAILURE (FT)
① MIN BREACH SECT.; MIN FAIL TIME	0	20	0.5H:1V	0.5	942.7
② MAX BREACH SECT.; MIN FAIL TIME	60	20	1H:1V	0.5	942.7
③ MIN BREACH SECT; MAX FAIL TIME	0	20	0.5H:1V	4.0	942.7
④ MAX BREACH SECT; MAX FAIL TIME	60	20	1H:1V	4.0	942.7
⑤ AVERAGE POSSIBLE CONDITIONS	30	20	0.5H:1V	1.0	942.7

* MAXIMUM TIME FOR BREACH SECTION TO REACH ITS FINAL DIMENSIONS

SUBJECT	DAM SAFETY INSPECTION UPPER CASTANEA RESERVOIR DAM
BY WJV DATE 6-3-80	PROJ. NO. 79-203-393
CHKD. BY DJS DATE 6-3-80	SHEET NO. 19 OF 21

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- THE BREACH ASSUMPTIONS LISTED ON SHEET 19 ARE BASED SOMEWHAT ON INFORMATION CONCERNING EARTH DAM BREACHING PROVIDED BY THE COE, BALTIMORE DISTRICT; AND ALSO ON THE PHYSICAL CONSTRAINTS OF THE DAM AND SURROUNDING TERRAIN:

CONSTRAINT	VALUE
HEIGHT OF DAM	≈ 27 FT (FIELD MEASURE[illegible]
EMBANKMENT CREST LENGTH:	
FOR CREST PORTION w/ ≈ 150 FT WIDTH	≈ 110 FT (FIELD MEASURE[illegible])
FOR CREST PORTION w/ ≈ 23 FT WIDTH	≈ 110 FT
TOTAL	≈ 220 FT
VALLEY BOTTOM WIDTH	≈ 100 FT (USG[illegible]
VALLEY SIDESLOPES ADJACENT TO DAM	
LEFT WALL	≈ 1.5H : 1V (USG[illegible]
RIGHT WALL	

UBJECT DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM

BY WJV DATE 6-3-80 PROJ. NO. 79-???-392
CHKD. BY DJS DATE 6-4-80 SHEET NO. 20 OF 21

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- HEC-1 BREACHING ANALYSIS OUTPUT :

RESERVOIR DATA

UNDER 0.41 PMF CONDITIONS -

*PLAN NUMBER	VARIABLE BREACH BOTTOM WIDTH (FT)	ACTUAL MAX FLOW DURING FAIL TIME (CFS)	CORRESPONDING TIME OF FLOW (HR)	INTERPOLATED OR HEC-1 ROUTED MAX FLOW DURING FAIL TIME (CFS)	CORRESPONDING TIME OF FLOW (HR)	ACTUAL PEAK FLOW THROUGH DAM (CFS)	CORRESPONDING TIME OF PEAK (HR)	TIME OF INITIAL BREACH (HR)
(1)	0	2121	42.83	2121	42.83	2121	42.83	42.33
(2)	60	2896	42.66	2895	42.67	2896	42.66	42.33
(3)	0	1772	42.75	1772	42.67	1772	42.75	42.33
(4)	60	1830	42.83	1830	42.83	1830	42.83	42.33
(5)	30	2316	43.08	2295	43.00	2316	43.08	42.33

* SEE TABLE ON SHEET 18

SUBJECT: DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM

BY: WJV DATE: 6-3-80 PROJ. NO. 79-203-393

CHKD. BY: DJJ DATE: 6-4-80 SHEET NO. 21 OF 21

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- HEC-1 BREACH ANALYSIS OUTPUT :

DOWNSTREAM ROUTING DATA

UNDER 0.41 PMF BASE FLOW CONDITIONS -

PLAN [1] NUMBER	VARIABLE BREACH BOTTOM WIDTH (FT)	OUTPUT @ SECTION 7 LOCATED 2250 FT DS FROM DAM: PEAK FLOW (CFS)	CORRESPONDING WSEL [2] (FT)	WSEL W/O BREACH [3] (FT)	Δ ELEV [4] (FT)	OUTPUT @ SECTION 8 LOCATED 2440 FT DS FROM DAM: PEAK FLOW (CFS)	CORRESPONDING WSEL [2] (FT)	WSEL W/O BREACH [3] (FT)	Δ ELEV [4] (FT)
1	0	2103	686.7	686.3	+0.4	2101	676.9	676.4	+0.5
2	60	2889	687.7	686.3	+1.4	2889	677.8	676.4	+1.4
3	0	1771	686.3	686.3	0.0	1771	676.4	676.4	0.0
4	60	1830	686.4	686.3	+0.1	1830	676.5	676.4	+0.1
5	30	2293	687.0	686.3	+0.7	2296	677.2	676.4	+0.8
			BUILDING @ EL 690 FT				HOUSE @ EL 680 FT		

PLAN [1] NUMBER	VARIABLE BREACH BOTTOM WIDTH (FT)	OUTPUT @ SECTION 9 LOCATED 3820 FT DS FROM DAM: PEAK FLOW (CFS)	CORRESPONDING WSEL [2] (FT)	WSEL W/O BREACH [3] (FT)	Δ ELEV [4] (FT)	OUTPUT @ SECTION 10 LOCATED 4780 FT DS FROM DAM: PEAK FLOW (CFS)	CORRESPONDING WSEL [2] (FT)	WSEL W/O BREACH [3] (FT)	Δ ELEV [4] (FT)
1	0	2032	616.1	615.8	+0.3	2021	574.2	573.3	+0.9
2	60	2935	616.7	615.8	+0.9	2941	577.1	573.3	+3.8
3	0	1771	615.8	615.8	0.0	1771	573.3	573.3	0.0
4	60	1829	615.9	615.8	+0.1	1829	573.5	573.3	+0.2
5	30	2271	616.3	615.8	+0.5	2272	575.1	573.3	+1.8
			HOUSES @ EL 616-619 FT				HOUSES @ EL 573-575 FT		

1. SEE TABLE ON SHEET 18;
2. WATER SURFACE ELEVATIONS CORRESPONDING TO BREACH FLOODS (SUMMARY INPUT/OUTPUT SHEETS, SHEETS Q, R);
3. BASE FLOW ELEVATIONS CORRESPONDING TO THE 0.41 PMF AS INTERPOLATED FROM SHEETS K, L , AND

SUBJECT DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM

BY WJV DATE 6-15-80 PROJ. NO. 79-203-393

CHKD. BY DJS DATE 6-17-80 SHEET NO. A OF R

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SUMMARY INPUT/OUTPUT SHEETS

OVERTOPPING ANALYSIS

DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM ****** OVERTOPPING ANALYSIS ******
10-MINUTE TIME STEP AND 48-HOUR STORM DURATION

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	10	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN=1 NRTIO=3 LRTIO=1

RTIOS = .40 .50 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

GENERATION OF FULL OR PARTIAL PMF HYDROGRAPH FOR THE HARVEYS RUN SUBAREA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.78	0.00	2.77	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.60	117.50	127.00	136.00	142.50	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

INITIAL + CONSTANT RAINFALL LOSS (C.O.E)

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 2.30 CP= .40 NTA= 0

BASEFLOW PARAMETERS (C.O.E.)

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=14.12 AND R=25.87 INTERVALS

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 2.30 HOURS, CP= .40 VOL= .97

2.	6.	12.	19.	28.	37.	47.	57.	66.	74.
80.	85.	89.	90.	88.	85.	82.	79.	76.	73.
70.	67.	65.	62.	60.	58.	56.	53.	51.	49.
48.	46.	44.	42.	41.	39.	38.	36.	35.	34.
32.	31.	30.	29.	28.	27.	26.	25.	24.	23.
22.	21.	20.	20.	19.	18.	17.	17.	16.	16.
15.	14.	14.	13.	13.	12.	12.	11.	11.	11.
10.	10.	9.	9.	9.	8.	8.	8.	7.	7.
7.	7.	6.	6.	6.	6.	5.	5.	5.	5.
5.	5.	4.	4.	4.	4.	4.	4.	3.	3.

NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	25.76	23.46	2.30	58011.
										(654.)(	596.)(	58.)(	1642.69)

RESERVOIR
INFLOW
HYDROGRAPHS
(HARVEY'S RUN SUB-BASIN)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME	
CFS	563.	452.	160.	80.	23109.	
CMS	16.	13.	5.	2.	654.	
INCHES		5.39	7.63	7.66	7.66	0.40 PMF
MM		136.84	193.87	194.45	194.45	
AC-FT		224.	317.	318.	318.	
THOUS CU M		276.	391.	393.	393.	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME	
CFS	703.	565.	200.	100.	28887.	
CMS	20.	16.	6.	3.	818.	
INCHES		6.73	9.54	9.57	9.57	0.50 PMF
MM		171.05	242.34	243.07	243.07	
AC-FT		280.	397.	398.	398.	
THOUS CU M		345.	489.	491.	491.	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME	
CFS	1407.	1129.	400.	201.	57773.	
CMS	40.	32.	11.	6.	1636.	
INCHES		13.47	19.08	19.14	19.14	PMF
MM		342.10	484.69	486.13	486.13	
AC-FT		560.	793.	796.	796.	
THOUS CU M		691.	979.	982.	982.	

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

GENERATION OF FULL OR PARTIAL PMF HYDROGRAPH FOR THE WEST KAMMERDINER SUBAREA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	1.93	0.00	2.77	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.60	117.50	127.00	136.00	142.50	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

INITIAL + CONSTANT RAINFALL LOSS (COE)

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 3.16 CP= .40 NTA= 0

BASEFLOW PARAMETERS (COE)

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=19.28 AND R=35.44 INTERVALS

SUBJECT DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM

BY WJV DATE 6-15-80 PROJ. NO. 79-203-393

CHKD. BY DJS DATE 6-17-80 SHEET NO. C OF R

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UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 3.15 HOURS, CP= .40 VOL= .92

2.	7.	14.	22.	32.	43.	54.	67.	79.	93.
106.	118.	129.	138.	146.	153.	158.	161.	163.	161.
157.	152.	148.	144.	140.	136.	132.	128.	125.	121.
118.	115.	112.	108.	105.	102.	100.	97.	94.	92.
89.	87.	84.	82.	79.	77.	75.	73.	71.	69.
67.	65.	63.	62.	60.	58.	57.	55.	54.	52.
51.	49.	48.	47.	45.	44.	43.	42.	40.	39.
38.	37.	36.	35.	34.	33.	32.	31.	30.	30.
29.	28.	27.	26.	26.	25.	24.	24.	23.	22.
22.	21.	21.	20.	19.	19.	18.	18.	17.	17.

END-OF-PERIOD FLOW

O MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	25.76	23.46	2.30	122687.
										(654.)(	596.)(	58.)(	3474.11)

RESERVOIR INFLOW HYDROGRAPHS

(WEST KAMMERDINER RUN SUBAREA)

0.40 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1135.	950.	330.	169.	48788.
CMS	32.	27.	10.	5.	1382.
INCHES		4.62	6.51	6.53	6.53
MM		117.32	165.44	165.91	165.91
AC-FT		475.	670.	672.	672.
THOUS CU M		586.	827.	829.	829.

0.60 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1419.	1190.	422.	212.	60985.
CMS	40.	34.	12.	6.	1727.
INCHES		5.77	8.14	8.16	8.16
MM		146.65	206.80	207.39	207.39
AC-FT		594.	838.	840.	840.
THOUS CU M		733.	1033.	1036.	1036.

PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2839.	2396.	845.	424.	121970.
CMS	80.	68.	24.	12.	3454.
INCHES		11.55	16.28	16.33	16.33
MM		293.30	413.60	414.78	414.78
AC-FT		1188.	1675.	1680.	1680.
THOUS CU M		1465.	2066.	2072.	2072.

SUB AREA RUNOFF COMPUTATIONS

GENERATION OF FULL OR PARTIAL PMF HYDROGRAPH FOR THE LOCAL RESERVOIR SUBAREA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.06	0.00	2.77	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.60	117.50	127.00	136.00	142.50	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

SUBJECT DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM

BY WJV DATE 6-15-80 PROJ. NO. 79-203-393

CHKD. BY DJS DATE 6-17-80 SHEET NO. D OF R

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LOSS DATA

INITIAL + CONSTANT RAINFALL LOSS (COE)

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 1.02 CP= .40 NTA= 0

BASEFLOW PARAMETERS (COE)

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 6.50 AND R=11.40 INTERVALS

UNIT HYDROGRAPH 64 END-OF-PERIOD ORDINATES, LAG= 1.03 HOURS, CP= .40 VOL= 1.00

1.	3.	6.	10.	13.	15.	15.	14.	13.	12.
11.	10.	9.	8.	8.	7.	6.	6.	5.	5.
5.	4.	4.	3.	3.	3.	3.	2.	2.	2.
2.	2.	2.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.						

0

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	25.76	23.46	2.30	5304.
										(654.)(	596.)(	58.)(	150.19)

RESERVOIR INFLOW HYDROGRAPHS

(LOCAL RESERVOIR SUBAREA)

.40 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	69.	45.	15.	7.	2121.
CMS	2.	1.	0.	0.	60.
INCHES		6.94	9.11	9.14	9.14
MM		176.34	231.27	232.03	232.03
AC-FT		22.	29.	29.	29.
THOUS CU M		27.	36.	36.	36.

.50 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	87.	56.	18.	9.	2651.
CMS	2.	2.	1.	0.	75.
INCHES		8.68	11.38	11.42	11.42
MM		220.42	289.09	290.04	290.04
AC-FT		28.	36.	37.	37.
THOUS CU M		34.	45.	45.	45.

PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	173.	112.	37.	18.	5303.
CMS	5.	3.	1.	1.	150.
INCHES		17.36	22.76	22.84	22.84
MM		440.85	578.18	580.08	580.08
AC-FT		56.	73.	73.	73.
THOUS CU M		68.	90.	90.	90.

SUBJECT DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM

BY WJV DATE 6-15-80 PROJ. NO. 79-203-393

CHKD. BY DJS DATE 6-17-80 SHEET NO. E OF R

GAI CONSULTANTS, INC.
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COMBINE HYDROGRAPHS

COMBINE ALL SUBAREA HYDROGRAPHS TO CONSTRUCT THE RESERVOIR INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	3	0	0	0	0	1	0	0

RESERVOIR INFLOW HYDROGRAPHS

(SUM OF HARVEYS RUN, WEST HAMMERUNE'S RUN, AND LOCAL RESERVOIR SUBAREA HYDROGRAPHS.)

0.40 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1729.	1439.	513.	257.	74018.
CMS	49.	41.	15.	7.	2096.
INCHES		4.83	6.88	6.90	6.90
MM		122.77	174.87	175.38	175.38
AC-FT		714.	1017.	1020.	1020.
THOUS CU M		880.	1254.	1258.	1258.

0.50 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2161.	1799.	641.	321.	92523.
CMS	61.	51.	18.	9.	2620.
INCHES		6.04	8.61	8.63	8.63
MM		153.46	218.59	219.23	219.23
AC-FT		892.	1271.	1274.	1274.
THOUS CU M		1100.	1567.	1572.	1572.

PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4322.	3598.	1281.	643.	185046.
CMS	122.	102.	36.	18.	5240.
INCHES		12.08	17.21	17.26	17.26
MM		306.93	437.19	438.45	438.45
AC-FT		1784.	2541.	2549.	2549.
THOUS CU M		2201.	3135.	3144.	3144.

HYDROGRAPH ROUTING

ROUTE INFLOW HYDROGRAPH THROUGH THE RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
404	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	33.	-1

STAGE	838.50	839.50	840.50	841.50	842.50	842.70	842.90	843.10	843.50
	845.00	845.70							
FLOW	0.00	170.00	530.00	1010.00	1620.00	1740.00	1890.00	2060.00	2470.00
	4320.00	5380.00							

CAPACITY=	0.	4.	9.	13.	17.	23.	26.	28.	30.	33.
	34.	36.	39.	41.	43.	44.	47.	50.	53.	56.
ELEVATION=	822.	82[illegible].	828.	830.	832.	835.	836.	837.	838.	839.
	839.	840.	841.	842.	843.	843.	844.	845.	846.	847.

SUBJECT DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM

BY WJV DATE 6-15-80 PROJ. NO. 79-203-393

CHKD. BY DJS DATE 6-17-80 SHEET NO. F OF R

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CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
838.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
842.7	0.0	0.0	0.

RESERVOIR OUTFLOW HYDROGRAPHS

PEAK OUTFLOW IS 1727. AT TIME 42.67 HOURS

	PEAK	6-HOUR	24 HOUR	12 HOUR	TOTAL VOLUME
CFS	1727.	1439.	510.	256.	73588.
CMS	49.	41.	14.	7.	2084.
INCHES		4.83	6.84	6.86	6.86
MM		122.76	173.86	174.36	174.36
AC-FT		714.	1011.	1014.	1014.
THOUS CU M		880.	1247.	1250.	1250.

0.40 PMF

PEAK OUTFLOW IS 2160. AT TIME 42.67 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2160.	1799.	637.	320.	92017.
CMS	61.	51.	18.	9.	2606.
INCHES		6.04	8.56	8.58	8.58
MM		153.45	217.40	218.03	218.03
AC-FT		892.	1264.	1267.	1267.
THOUS CU M		1100.	1559.	1563.	1563.

0.50 PMF

PEAK OUTFLOW IS 4321. AT TIME 42.67 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4321.	3598.	1276.	640.	184252.
CMS	122.	102.	36.	18.	5217.
INCHES		12.08	17.14	17.19	17.19
MM		306.89	435.37	436.57	436.57
AC-FT		1784.	2531.	2538.	2538.
THOUS CU M		2201.	3121.	3130.	3130.

PMF

SUBJECT DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM

BY WJV DATE 6-15-80 PROJ. NO. 79-203-393

CHKD. BY DJS DATE 6-17-80 SHEET NO. G OF R

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                              HYDROGRAPH ROUTING

               ROUTE FROM DAM TO SECTION 5, 1260 FT D.S. FROM DAM

                 ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                   405       1       0       0       0       0       1       0       0
                                      ROUTING DATA
         QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
           0.0   0.000    0.00       1       1       0       0               0

                 NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                     1       0       0   0.000   0.000   0.000     -1.       0


NORMAL DEPTH CHANNEL ROUTING
----------------------------

    QN(1)   QN(2)   QN(3)   ELNVT   ELMAX   RLNTH     SEL
    .1000   .0400   .1000   740.0   800.0   1260.  .05900

    CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
      0.00  800.00   50.00  780.00  180.00  748.00  190.00  740.00  210.00  740.00
    220.00  748.00  250.00  760.00  350.00  800.00

STORAGE       0.00       2.19       5.10       8.85      14.34      21.71      30.98      42.15      55.20
             86.99     105.73     126.35     148.85     172.89     198.37     225.29     253.65     283.46
OUTFLOW       0.00    1264.26    4267.48    9493.40   17477.17   28022.60   41362.56   57717.33   77299.57
         126967.09  157449.53  191954.71  231026.93  275064.33  323391.76  376103.11  433296.24  495071.51

STAGE       740.00     743.16     746.32     749.47     752.63     755.79     758.95     762.11     765.26
            771.58     774.74     777.89     781.05     784.21     787.37     790.53     793.68     796.84

FLOW          0.00    1264.26    4267.48    9493.40   17477.17   28022.60   41362.56   57717.33   77299.57
         126967.09  157449.53  191954.71  231026.93  275064.33  323391.76  376103.11  433296.24  495071.51


**********          **********          **********          **********          **********

                              HYDROGRAPH ROUTING

               ROUTE FROM SECTION 5 TO SECTION 6, 1800 FT D.S. FROM DAM

                 ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                   506       1       0       0       0       0       1       0       0
                                      ROUTING DATA
         QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
           0.0   0.000    0.00       1       1       0       0               0

                 NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                     1       0       0   0.000   0.000   0.000     -1.       0
```

SUBJECT: DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM

BY: WJV DATE: 6-15-80 PROJ. NO. 79-202-393

CHKD. BY: DJS DATE: 6-17-80 SHEET NO. H OF R

GAI CONSULTANTS, INC.
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NORMAL DEPTH CHANNEL ROUTING
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        QN(1)    QN(2)    QN(3)    ELNVT    ELMAX    RLNTH      SEL
        .1000    .0400    .1000    712.0    780.0     540.   .08000


        CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
             0.00  780.00  230.00  726.00  380.00  720.00  390.00  712.00  410.00  712.00
           420.00  720.00  520.00  740.00  700.00  780.00

  STORAGE        0.00        1.09        2.57        5.73       13.51       24.14       36.23       49.80       64.83
                99.13      118.37      138.99      161.01      184.41      209.21      235.40      262.98      291.95

  OUTFLOW        0.00     1826.44     6236.10    14892.10    30886.36    57215.26    92529.87   136826.36   190345.67
            326265.60   409064.84   502190.94   605982.07   720780.80   846931.43   984778.26  1134664.51  1296931.61  1

  STAGE        712.00      715.58      719.16      722.74      726.32      729.89      733.47      737.05      740.63
               747.79      751.37      754.95      758.53      762.11      765.68      769.26      772.84      776.42

  FLOW           0.00     1826.44     6236.10    14892.10    30886.36    57215.26    92529.87   136826.36   190345.67
            326265.60   409064.84   502190.94   605982.07   720780.80   846931.43   984778.26  1134664.51  1296931.61  1
                                                  HYDROGRAPH ROUTING

                      ROUTE FROM SECTION 6 TO SECTION 7. 2250 FT D.S. FROM DAM

                                 ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                                   607       1       0       0       0       0       1       0       0
                                                     ROUTING DATA
                        QLOSS    CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
                          0.0    0.000    0.00       1       1       0       0               0

                                 NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                                     1       0       0   0.000   0.000   0.000     -1.       0


NORMAL DEPTH CHANNEL ROUTING
----------------------------

        QN(1)    QN(2)    QN(3)    ELNVT    ELMAX    RLNTH      SEL
        .1000    .0400    .1000    682.0    720.0     450.   .06200


        CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
             0.00  720.00  250.00  690.00  290.00  690.00  300.00  682.00  315.00  682.00
           325.00  690.00  375.00  700.00  400.00  720.00

  STORAGE        0.00         .36         .83        1.39        2.07        3.89        6.27        9.19       12.67
                21.20       26.10       31.40       37.09       43.17       49.66       56.53       63.81       71.48

  OUTFLOW        0.00      450.59     1500.99     3126.91     5369.48     9402.25    15015.16    22284.45    31330.34
             55536.52    70803.01    88160.18   107666.14   129383.20   153376.14   179711.11   208454.99   239674.96

  STAGE        682.00      684.00      686.00      688.00      690.00      692.00      694.00      696.00      698.00
               702.00      704.00      706.00      708.00      710.00      712.00      714.00      716.00      718.00

  FLOW           0.00      450.59     1500.99     3126.91     5369.48     9402.25    15015.16    22284.45    31330.34
             55536.52    70803.01    88160.18   107666.14   129383.20   153376.14   179711.11   208454.99   239674.96
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SUBJECT DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM

BY WJV DATE 6-15-80 PROJ. NO. 79-203-393

CHKD. BY DJS DATE 6-17-80 SHEET NO. I OF R

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                              HYDROGRAPH ROUTING

             ROUTE FROM SECTION 7 TO SECTION 8, 2440 FT D.S. FROM DAM
                   ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                     708       1       0       0       0       0       1       0       0
                                          ROUTING DATA
            QLOSS  CLOSS     AVG    IRES   ISAME    IOPT    IPMP                  LSTR
              0.0  0.000    0.00       1       1       0       0                     0

                   NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                       1       0       0   0.000   0.000   0.000     -1.       0

NORMAL DEPTH CHANNEL ROUTING
----------------------------

     QN(1)   QN(2)   QN(3)   ELNVT   ELMAX   RLNTH     SEL
     .1000   .0400   .1000   672.0   720.0    190.  .05700

     CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
       0.00  720.00  100.00  700.00  325.00  680.00  335.00  672.00  350.00  672.00
     360.00  680.00  400.00  700.00  450.00  720.00

STORAGE         0.00        .20        .47        .81       1.32       2.20       3.45       5.06       7.04
               12.12      15.21      18.60      22.20      26.01      30.03      34.26      38.70      43.34

OUTFLOW         0.00     644.75    2188.83    4644.20    8790.42   14720.14   22717.60   33109.34   46191.36
            81516.89  104272.43  132133.57  163746.75  199012.25  237980.46  280712.14  327274.99  377741.53

STAGE         672.00     674.53     677.05     679.58     682.11     684.63     687.16     689.68     692.21
              697.26     699.79     702.32     704.84     707.37     709.89     712.42     714.95     717.47

FLOW            0.00     644.75    2188.83    4644.20    8790.42   14720.14   22717.60   33109.34   46191.36
            81516.89  104272.43  132133.57  163746.75  199012.25  237980.46  280712.14  327274.99  377741.53
                              HYDROGRAPH ROUTING

             ROUTE FROM SECTION 8 TO SECTION 9, 3820 FT D.S. FROM DAM
                   ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                     809       1       0       0       0       0       1       0       0
                                          ROUTING DATA
            QLOSS  CLOSS     AVG    IRES   ISAME    IOPT    IPMP                  LSTR
              0.0  0.000    0.00       1       1       0       0                     0

                   NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                       1       0       0   0.000   0.000   0.000     -1.       0

NORMAL DEPTH CHANNEL ROUTING
----------------------------

     QN(1)   QN(2)   QN(3)   ELNVT   ELMAX   RLNTH     SEL
     .1000   .0400   .1000   609.0   640.0   1380.  .02900
```

SUBJECT DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM

BY WJV DATE 6-15-80 PROJ. NO. 79-203-393

CHKD. BY DDS DATE 6-17-80 SHEET NO. J OF R

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CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 640.00 250.00 620.00 400.00 614.00 400.00 609.00 412.00 609.00
412.00 614.00 850.00 620.00 950.00 640.00

STORAGE	0.00	.62	1.24	1.86	6.10	18.58	39.33	68.12	100.25
	168.94	205.50	243.54	283.05	324.04	366.50	410.44	455.86	502.75
OUTFLOW	0.00	146.63	409.10	721.68	1400.07	3360.90	7380.62	14449.11	25472.70
	55635.92	74594.08	96080.96	120081.30	146592.54	175621.13	207180.10	241287.40	277964.81
STAGE	609.00	610.63	612.26	613.89	615.53	617.16	618.79	620.42	622.05
	625.32	626.95	628.58	630.21	631.84	633.47	635.11	636.74	638.37
FLOW	0.00	146.63	409.10	721.68	1400.07	3360.90	7380.62	14449.11	25472.70
	55635.92	74594.08	96080.96	120081.30	146592.54	175621.13	207180.10	241287.40	277964.81

HYDROGRAPH ROUTING

ROUTE FROM SECTION 9 TO SECTION 10, 4780 FT D.S. FROM DAM

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
9010	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0400	.1000	565.0	600.0	960.	.04300

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 600.00 350.00 580.00 550.00 578.00 550.00 565.00 562.00 565.00
562.00 578.00 950.00 580.00 1200.00 600.00

STORAGE	0.00	.49	.97	1.46	1.95	2.44	2.92	3.41	13.67
	66.03	95.68	127.57	161.70	198.08	236.70	277.57	320.67	366.02
OUTFLOW	0.00	214.64	592.03	1036.12	1516.05	2017.69	2533.52	3059.16	5054.68
	27211.68	45954.38	69413.08	97559.10	130429.80	168099.35	210664.05	258234.24	310929.41
STAGE	565.00	566.84	568.68	570.53	572.37	574.21	576.05	577.89	579.74
	583.42	585.26	587.11	588.95	590.79	592.63	594.47	596.32	598.16
FLOW	0.00	214.64	592.03	1036.12	1516.05	2017.69	2533.52	3059.16	5054.68
	[illegible]	45954.38	69413.08	97559.10	130429.80	168099.35	210664.05	258234.24	310929.41

SUBJECT DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM

BY WJV DATE 6-15-80 PROJ. NO. 79-203-393

CHKD. BY DJS DATE 6-17-80 SHEET NO. K OF R

GAI CONSULTANTS, INC.
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SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	838.50	838.50	842.70
STORAGE	33.	33.	43.
OUTFLOW	0.	0.	1740.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.40	842.68	0.00	43.	1727.	0.00	42.67	0.00
.50	843.20	.50	44.	2160.	3.50	42.67	0.00
1.00	845.00	2.30	50.	4321.	8.33	42.67	0.00

UPPER CASTANEA RESERVOIR DAM; OVERTOPPING OCCURS @ ≈ .40 PMF.

SECTION 5
@ ≈ 1260 FT
D.S. FROM DAM

PLAN 1 STATION 405

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.40	1727.	743.6	42.67
.50	2160.	744.1	42.67
1.00	4320.	746.3	42.67

SECTION 6
@ ≈ 1800 FT
D.S. FROM DAM

PLAN 1 STATION 506

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.40	1727.	715.4	42.67
.50	2160.	715.8	42.67
1.00	4321.	717.6	42.67

SECTION 7
@ ≈ 2250 FT
D.S. FROM DAM

PLAN 1 STATION 607

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.40	1727.	686.3	42.67
.50	2160.	686.8	42.67
1.00	4320.	689.1	42.67

PLAN 1 STATION 708

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.40	1727.	676.3	42.67
.50	2160.	677.0	42.67
1.00	4320.	679.2	42.67

SECTION 8
@ ≈ 2440 FT
D.S. FROM DAM

PLAN 1 STATION 809

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.40	1727.	615.8	42.83
.50	2159.	616.2	42.83
1.00	4317.	617.5	42.83

SECTION 9
@ ≈ 3820 FT
D.S. FROM DAM

PLAN 1 STATION 9010

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.40	1727.	573.1	42.83
.50	2159.	574.7	42.83
1.00	4318.	579.1	42.83

SECTION 10
@ ≈ 4780 FT
D.S. FROM DAM

SUBJECT DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM

BY WJV DATE 6-15-80 PROJ. NO. 79-203-393

CHKD. BY DJS DATE 6-17-80 SHEET NO. L OF R

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BREACHING ANALYSIS (INPUT SAME AS FOR OVERTOPPING ANALYSIS WITH THE ADDITION OF BREACHING DATA GIVEN HERE)

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DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM ****** BREACHING   ANALYSIS ******
10-MINUTE TIME STEP AND 48-HOUR STORM DURATION

                                JOB SPECIFICATION
   NQ      NHR      NMIN     IDAY      IHR      IMIN    METRC     IPLT     IPRT    NSTAN
  288        0        10        0        0         0        0        0        0        0
                            JOPER      NWT     LROPT    TRACE
                                5        0         0        0

                        MULTI-PLAN ANALYSES TO BE PERFORMED
                          NPLAN= 5 NRTIO= 1 LRTIO= 1
  RTIOS=     .41

                              HYDROGRAPH ROUTING

ROUTE INFLOW HYDROGRAPH THROUGH THE RESERVOIR

           ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
             404       1       0       0       0       0       1       0       0

                           ALL PLANS HAVE SAME
                              ROUTING DATA
      QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
        0.0   0.000    0.00       1       1       0       0               0

           NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
               1       0       0   0.000   0.000   0.000     33.      -1

STAGE      838.50    839.50    840.50    841.50    842.50    842.70    842.90    843.10    843.50
           845.00    845.70

FLOW         0.00    170.00    530.00   1010.00   1620.00   1740.00   1890.00   2060.00   2470.00
          4320.00   5380.00

CAPACITY=      0.        4.        9.       13.       17.       23.       26.       28.       30.       33.
              34.       36.       39.       41.       43.       44.       47.       50.       53.       56.

ELEVATION=   822.      825.      828.      830.      832.      835.      836.      837.      838.      839.
             839.      840.      841.      842.      843.      843.      844.      845.      846.      847.

          CREL   SPWID    COQW    EXPW   ELEVL    COOL   CAREA    EXPL
         838.5     0.0     0.0     0.0     0.0     0.0     0.0     0.0

                            DAM DATA
                   TOPEL    COQD    EXPD   DAMWID
                   842.7     0.0     0.0       0.
```

SUBJECT DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM

BY WJV DATE 6-15-80 PROJ. NO. 79-203-393

CHKD. BY DJS DATE 6-17-80 SHEET NO. M OF R

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PLAN 1

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
0.	.50	822.70	.50	838.50	842.70

BEGIN DAM FAILURE AT 42.33 HOURS

PEAK OUTFLOW IS 2121. AT TIME 42.83 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2121.	1494.	528.	265.	76279.
CMS	60.	42.	15.	7.	2160.
INCHES		5.02	7.10	7.12	7.12
MM		127.44	180.22	180.74	180.74
AC-FT		741.	1048.	1051.	1051.
THOUS CU M		914.	1292.	1296.	1296.

PLAN 2

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
60.	1.00	822.70	.50	838.50	842.70

BEGIN DAM FAILURE AT 42.33 HOURS

PEAK OUTFLOW IS 2896. AT TIME 42.66 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2895.	1541.	539.	270.	77779.
CMS	82.	44.	15.	8.	2202.
INCHES		5.17	7.24	7.26	7.26
MM		131.44	183.78	184.29	184.29
AC-FT		764.	1068.	1071.	1071.
THOUS CU M		943.	1318.	1321.	1321.

PLAN 3

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
0.	.50	822.70	4.00	838.50	842.70

BEGIN DAM FAILURE AT 42.33 HOURS

PEAK OUTFLOW IS 1772. AT TIME 42.75 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1772.	1493.	528.	265.	76275.
CMS	50.	42.	15.	7.	2160.
INCHES		5.01	7.10	7.12	7.12
MM		127.36	180.22	180.73	180.73
AC-FT		740.	1048.	1051.	1051.
THOUS CU M		913.	1292.	1296.	1296.

SUBJECT DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM

BY WJV DATE 6-15-80 PROJ. NO. 79-203-393

CHKD. BY DJS DATE 6-17-80 SHEET NO. N OF R

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PLAN 4

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
60.	1.00	822.70	4.00	838.50	842.70

BEGIN DAM FAILURE AT 42.33 HOURS

PEAK OUTFLOW IS 1830. AT TIME 42.83 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1830.	1544.	539.	270.	77878.
CMS	52.	44.	15.	8.	2205.
INCHES		5.18	7.24	7.26	7.26
MM		131.60	184.01	184.53	184.53
AC-FT		765.	1070.	1073.	1073.
THOUS CU M		944.	1319.	1323.	1323.

PLAN 5

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
30.	.50	822.70	1.00	838.50	842.70

BEGIN DAM FAILURE AT 42.33 HOURS

PEAK OUTFLOW IS 2316. AT TIME 43.08 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2285.	1539.	538.	270.	77756.
CMS	65.	44.	15.	8.	2202.
INCHES		5.17	7.21	7.25	7.25
MM		131.31	183.17	184.24	184.24
AC-FT		763.	1064.	1071.	1071.
THOUS CU M		942.	1317.	1321.	1321.

SUBJECT DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM

BY WJV DATE 6-15-80 PROJ. NO. 79-203-393

CHKD. BY DJS DATE 6-17-80 SHEET NO. O OF R

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THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .021 HOURS DURING BREACH FORMATION.
DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF .167 HOURS.
THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.
INTERMEDIATE FLOWS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

TIME (HOURS)	TIME FROM BEGINNING OF BREACH (HOURS)	INTERPOLATED BREACH HYDROGRAPH (CFS) -	COMPUTED BREACH HYDROGRAPH (CFS)	ERROR (CFS)	ACCUMULATED ERROR (CFS)	ACCUMULATED ERROR (AC-FT)
42.333	0.000	1748.	1748.	0.	0.	0.
42.354	.021	1772.	1772.	0.	0.	0.
42.375	.042	1795.	1803.	-8.	-8.	-0.
42.396	.063	1818.	1834.	-16.	-24.	-0.
42.417	.083	1841.	1862.	-20.	-44.	-0.
42.438	.104	1865.	1885.	-20.	-64.	-0.
42.458	.125	1888.	1904.	-16.	-80.	-0.
42.479	.146	1911.	1920.	-9.	-89.	-0.
42.500	.167	1934.	1934.	0.	-89.	-0.
42.521	.188	1944.	1947.	-3.	-93.	-0.
42.542	.208	1953.	1957.	-5.	-97.	-0.
42.563	.229	1962.	1961.	1.	-96.	-0.
42.583	.250	1971.	1964.	7.	-89.	-0.
42.604	.271	1980.	1969.	11.	-78.	-0.
42.625	.292	1990.	1976.	14.	-64.	-0.
42.646	.313	1999.	1995.	4.	-60.	-0.
42.667	.333	2008.	2008.	0.	-60.	-0.
42.688	.354	2015.	2017.	-2.	-62.	-0.
42.708	.375	2022.	2020.	2.	-60.	-0.
42.729	.396	2029.	2022.	7.	-53.	-0.
42.750	.417	2036.	2027.	9.	-44.	-0.
42.771	.437	2043.	2046.	-3.	-48.	-0.
42.792	.458	2050.	2058.	-8.	-56.	-0.
42.813	.479	2057.	2062.	-6.	-62.	-0.
42.833	.500	2064.	2064.	-0.	-62.	-0.
42.854	.521	2091.	2078.	13.	-48.	-0.
42.875	.542	2119.	2109.	10.	-39.	-0.
42.896	.562	2147.	2127.	20.	-19.	-0.
42.917	.583	2174.	2133.	41.	22.	0.
42.938	.604	2202.	2175.	27.	49.	0.
42.958	.625	2230.	2225.	4.	53.	0.
42.979	.646	2257.	2262.	-4.	49.	0.
43.000	.667	2285.	2285.	0.	49.	0.
43.021	.687	2283.	2298.	-15.	33.	0.
43.042	.708	2280.	2307.	-27.	7.	0.
43.063	.729	2278.	2313.	-34.	-28.	-0.
43.083	.750	2276.	2316.	-40.	-68.	-0.
43.104	.771	2274.	2310.	-37.	-105.	-0.
43.125	.792	2271.	2299.	-27.	-132.	-0.
43.146	.812	2269.	2286.	-17.	-149.	-0.
43.167	.833	2267.	2267.	0.	-149.	-0.
43.188	.854	2260.	2253.	7.	-142.	-0.
43.208	.875	2254.	2242.	11.	-131.	-0.
43.229	.896	2247.	2235.	12.	-118.	-0.
43.250	.917	2240.	2228.	12.	-106.	-0.
43.271	.937	2233.	2223.	10.	-96.	-0.
43.292	.958	2227.	2219.	8.	-88.	-0.
43.313	.979	2220.	2216.	4.	-84.	-0.
43.333	1.000	2213.	2213.	0.	-84	-0.

PLAN 5

SUBJECT DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM

BY WJV DATE 6-15-80 PROJ. NO. 79-203-393

CHKD. BY DJS DATE 6-17-80 SHEET NO. P OF R

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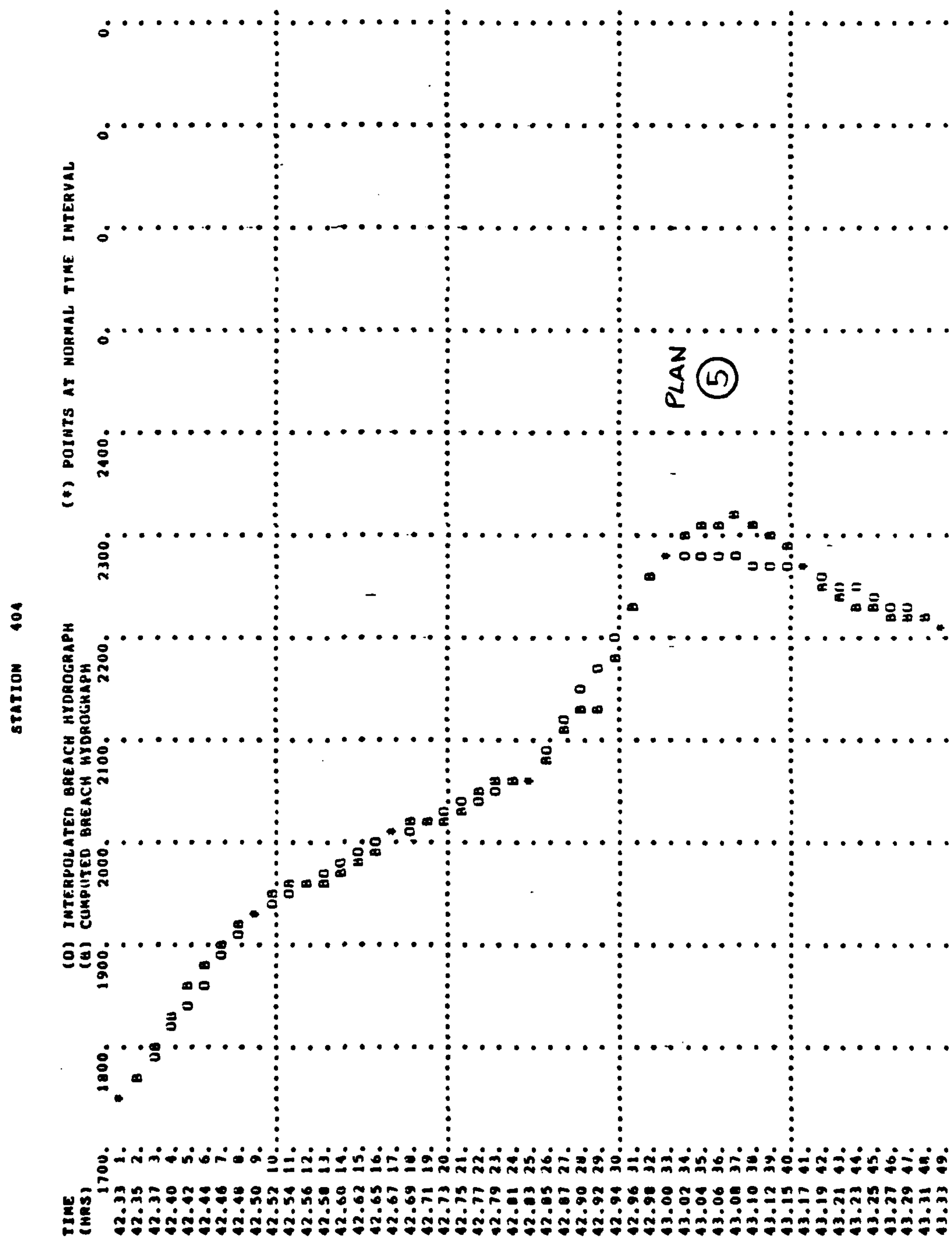

SUBJECT DAM SAFETY INSPECTION
UPPER CASTANEA RESERVOIR DAM

BY WJV DATE 6-15-80 PROJ. NO. 79-203-393

CHKD. BY DJJ DATE 6-17-80 SHEET NO. 9 OF R

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SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	838.50	838.50	842.70
STORAGE	33.	33.	43.
OUTFLOW	0.	0.	1740.

PLAN	RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1	.41	842.72	.02	43.	2121.	.26	42.83	42.33
2	.41	842.71	.01	43.	2896.	.18	42.66	42.33
3	.41	842.74	.04	43.	1772.	.75	42.75	42.33
4	.41	842.71	.01	43.	1830.	.17	42.83	42.33
5	.41	842.71	.01	43.	2316.	.19	43.08	42.33

STATION 405

PLAN	RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1	.41	2111.	744.0	42.83
2	.41	2895.	744.9	42.67
3	.41	1772.	743.7	42.67
4	.41	1829.	743.8	42.67
5	.41	2283.	744.2	43.17

STATION 506

	RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1	.41	2106.	715.8	42.83
2	.41	2895.	716.4	42.67
3	.41	1771.	715.5	42.67
4	.41	1829.	715.6	42.67
5	.41	2287.	716.0	43.17

STATION 607

	RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1	.41	2103.	686.7	42.83
2	.41	2889.	687.7	42.67
3	.41	1771.	686.3	42.67
4	.41	1830.	686.4	42.67
5	.41	2293.	687.0	43.17

STATION 708

	RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1	.41	2101.	676.9	42.83
2	.41	2889.	677.8	42.67
3	.41	1771.	676.4	42.83
4	.41	1830.	676.5	42.67
5	.41	2296.	677.2	43.17

STATION 809

	RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1	.41	2032.	616.1	42.83
2	.41	2835.	616.7	42.83
3	.41	1771.	615.8	42.83
4	.41	1829.	615.9	42.83
5	.41	2277.	616.3	43.17

SUBJECT DAM SAFETY INSPECTION

UPPER CASTANEA RESERVOIR DAM

BY WJV DATE 6-15-80 PROJ. NO. 79-203-393

CHKD. BY DJS DATE 6-17-80 SHEET NO. R OF R

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PLAN

STATION 9010

	RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1	.41	2021.	574.2	42.83
2	.41	2841.	577.1	42.83
3	.41	1771.	573.3	42.83
4	.41	1829.	573.5	42.83
5	.41	2272.	575.1	43.17

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AD-A087 761 GAI CONSULTANTS INC MONROEVILLE PA F/G 13/13
NATIONAL DAM INSPECTION PROGRAM. UPPER CASTANEA RESERVOIR DAM. --ETC(U)
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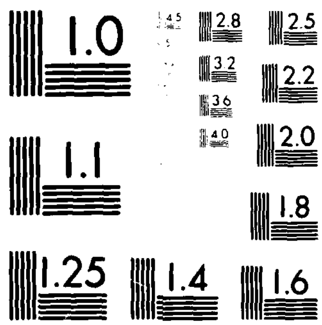


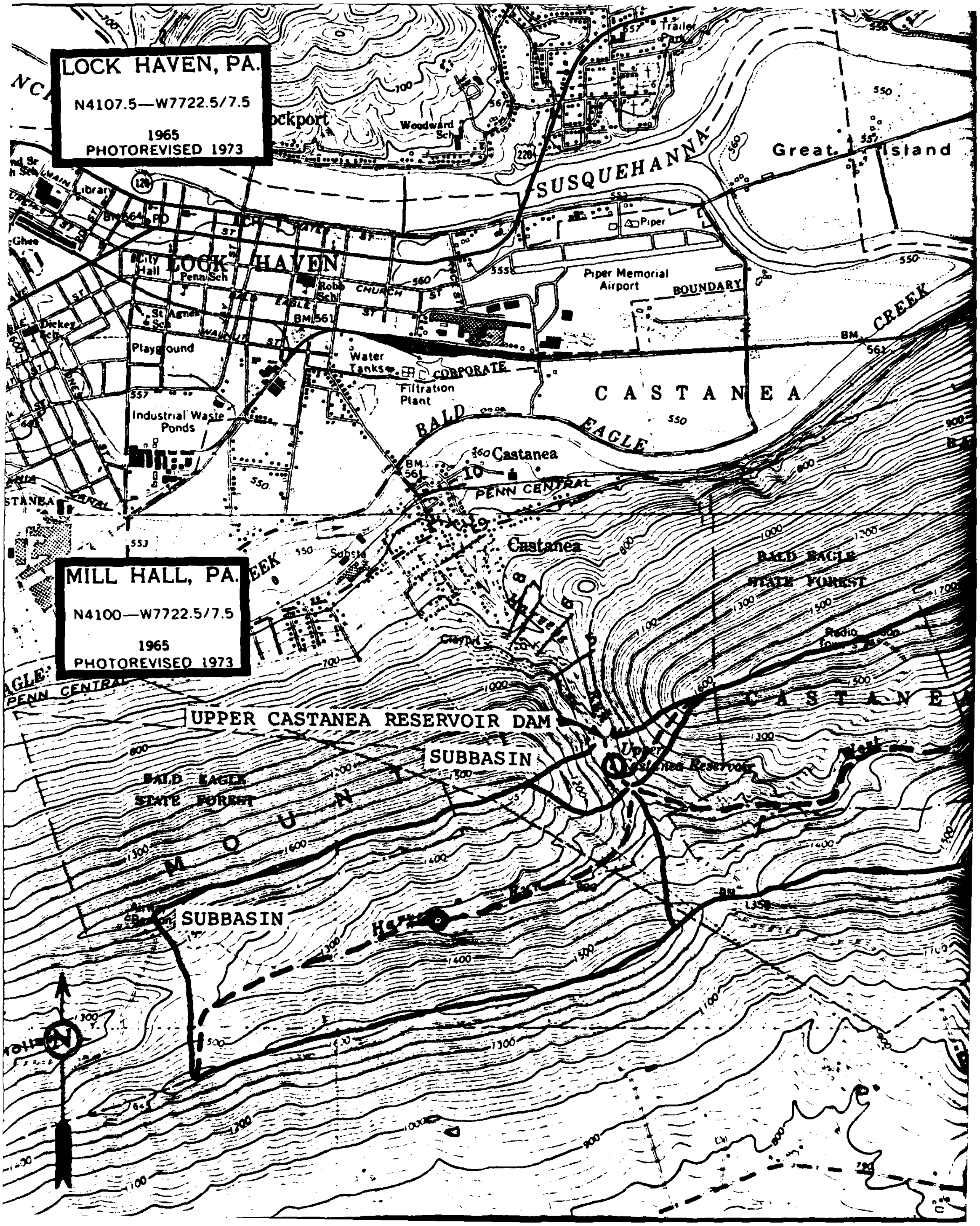
MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS-1963-A

APPENDIX E

FIGURES

LIST OF FIGURES


LOCK HAVEN, PA.
N4107.5—W7722.5/7.5
1965
PHOTOREVISED 1973
MILL HALL, PA.
N4100—W7722.5/7.5
1965
PHOTOREVISED 1973
LOCK HAVEN
SUSQUEHANNA
Great Island
Piper Memorial Airport
CORPORATE BOUNDARY
C A S T A N E A
BALD EAGLE CREEK
Castanea
PENN CENTRAL
Water Tanks
Filtration Plant
Industrial Waste Ponds
Playground
City Hall
Library
UPPER CASTANEA RESERVOIR DAM
SUBBASIN
BALD EAGLE STATE FOREST
M O U N T
Upper Castanea Reservoir
SUBBASIN

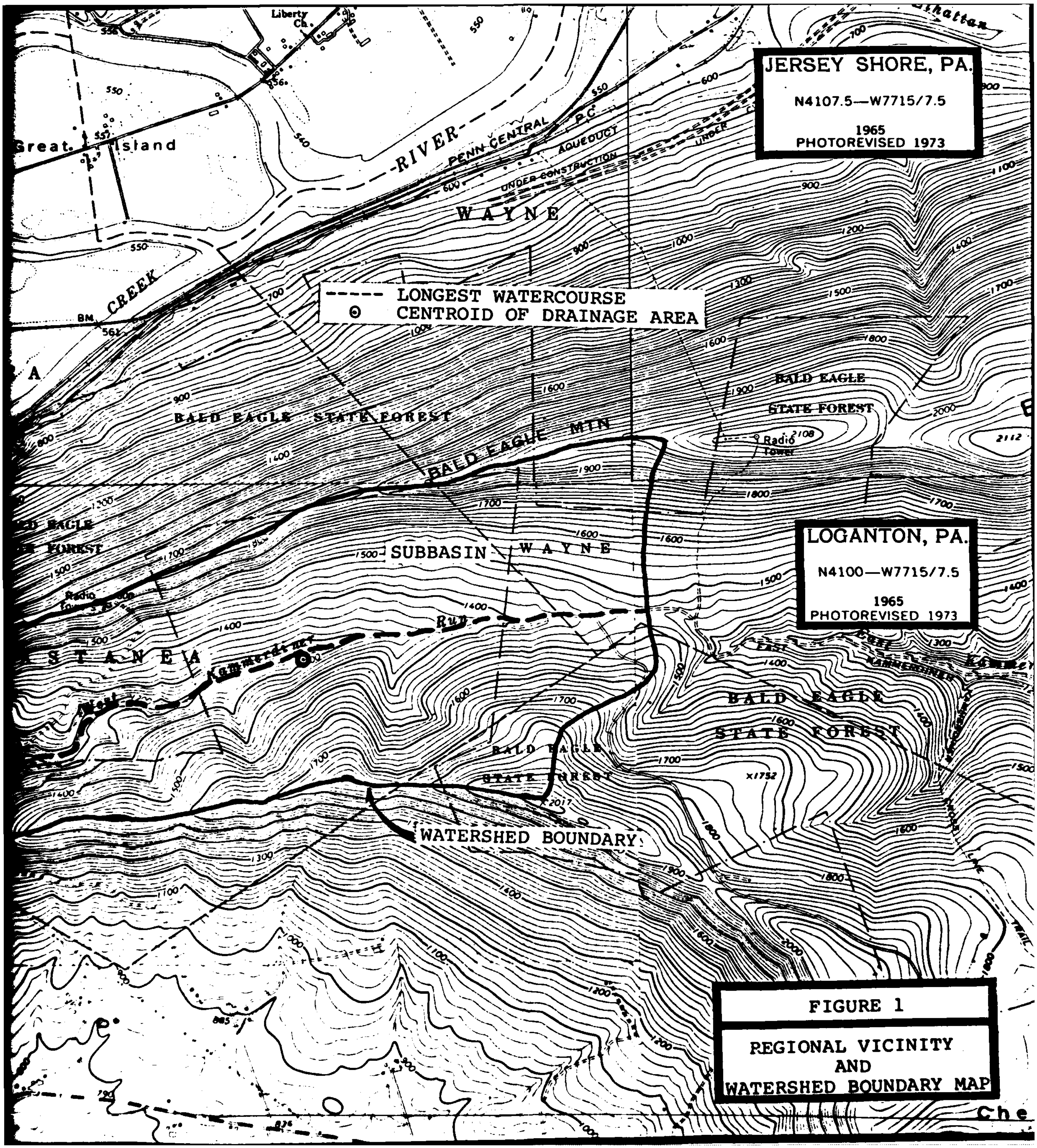
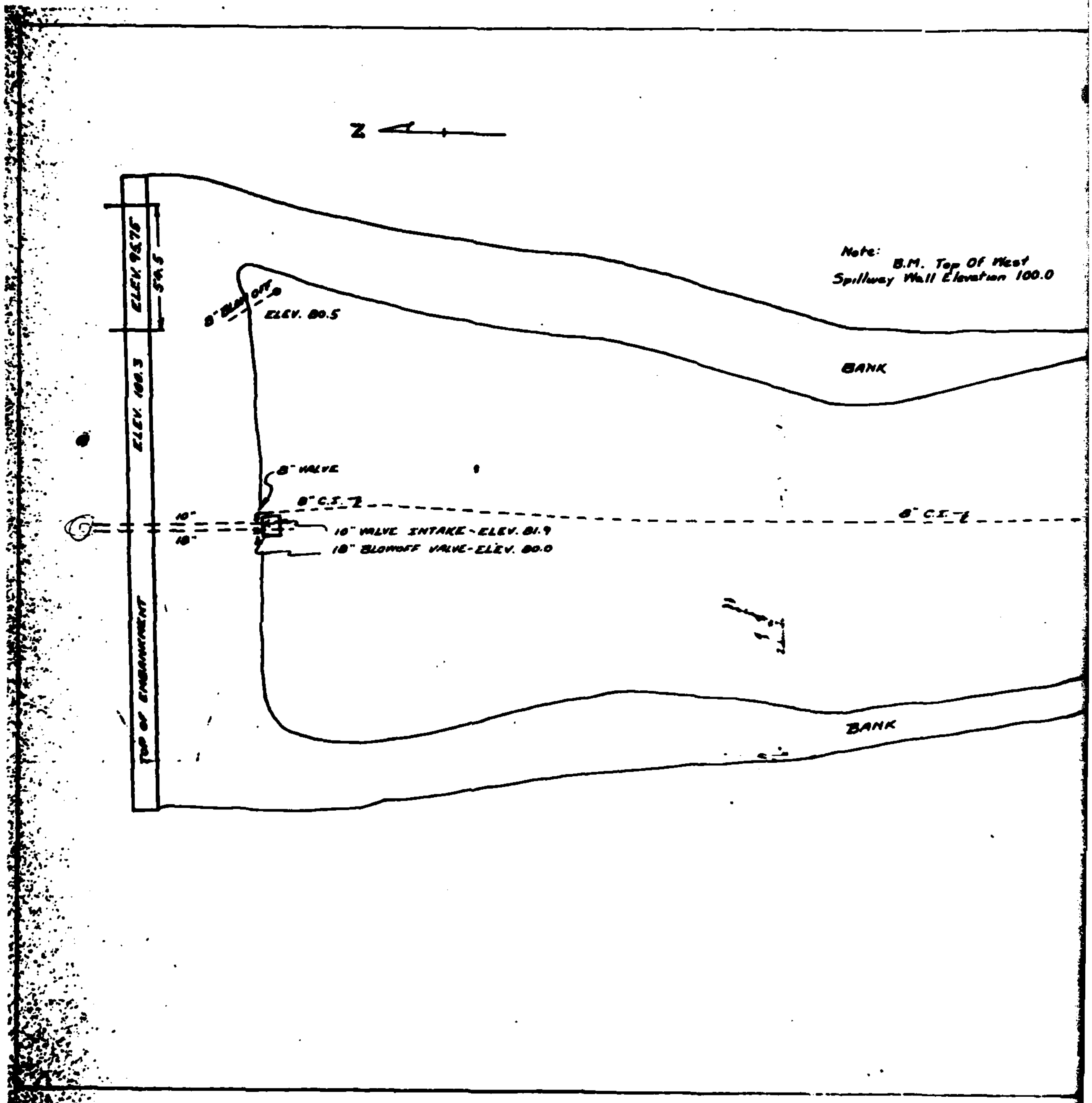


FIGURE 1

REGIONAL VICINITY AND WATERSHED BOUNDARY MAP



Z
Note: B.M. Top Of West Spillway Wall Elevation 100.0
ELEV. 95.75
59.5
ELEV. 100.3
TOP OF EMBANKMENT
8" BLOW OFF
ELEV. 80.5
BANK
8" VALVE
8" C.S. ℄
10"
10"
10" VALVE INTAKE - ELEV. 81.9
10" BLOWOFF VALVE - ELEV. 80.0
8" C.I. ℄
BANK

2

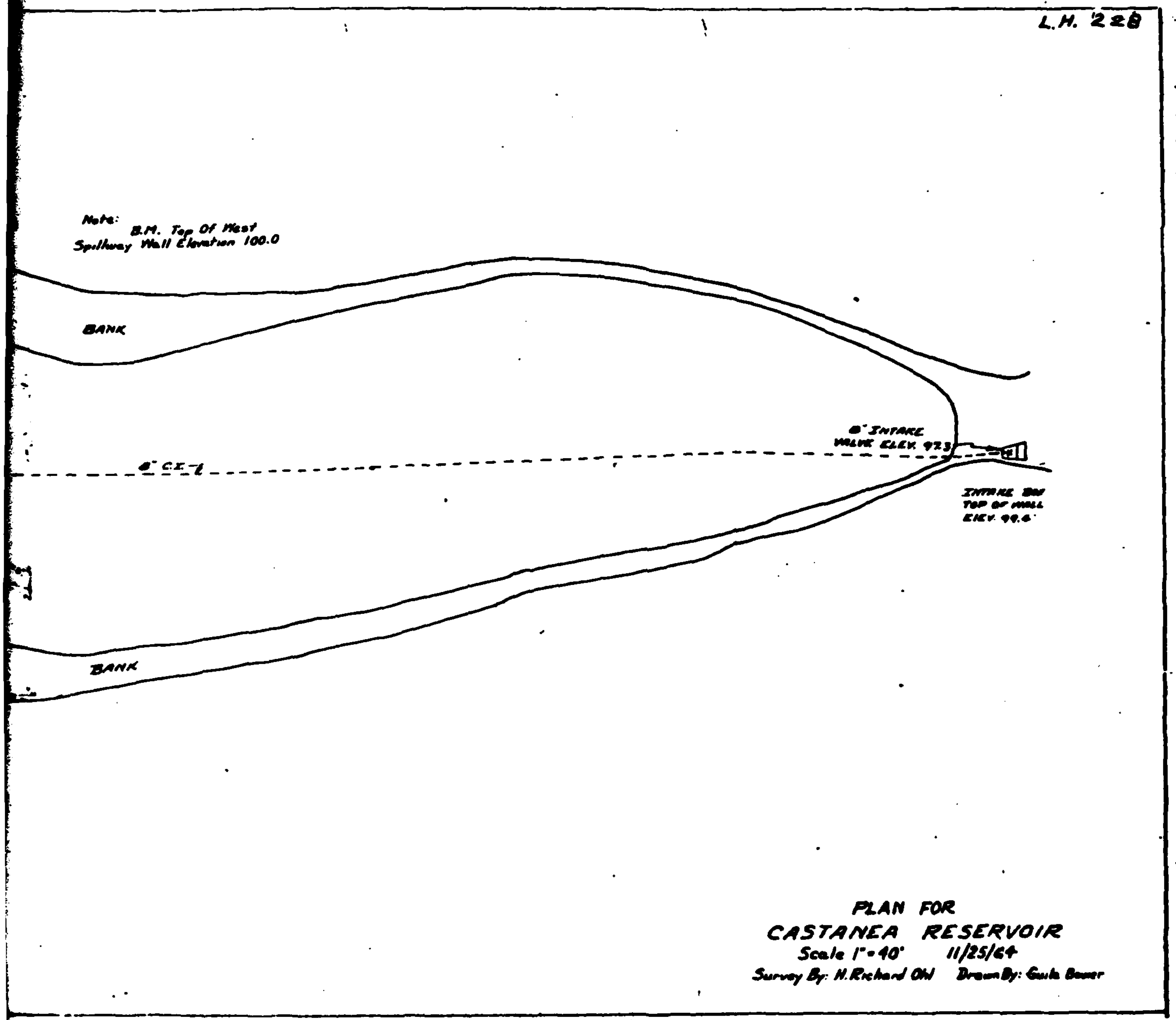


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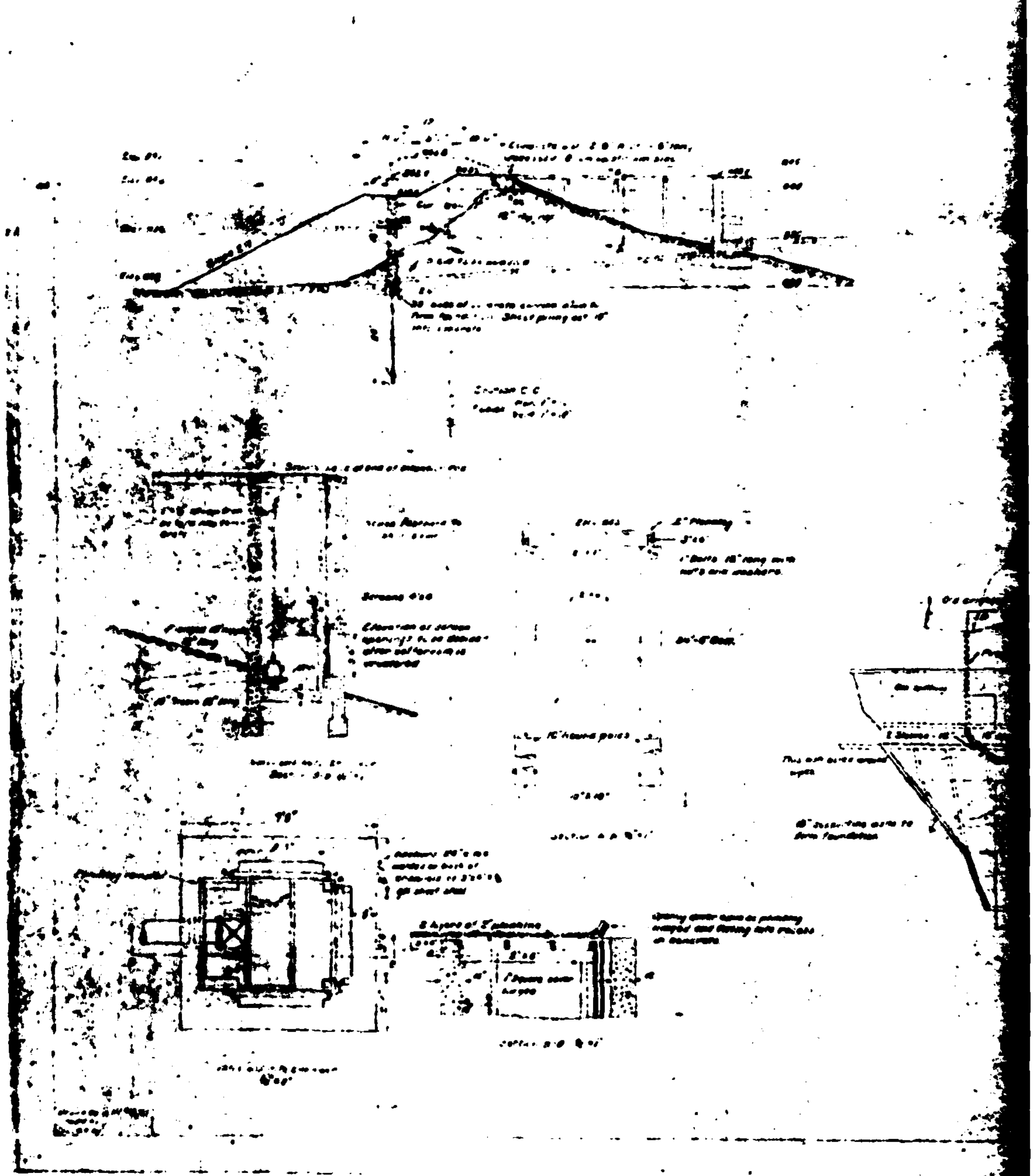
FIGURE 2



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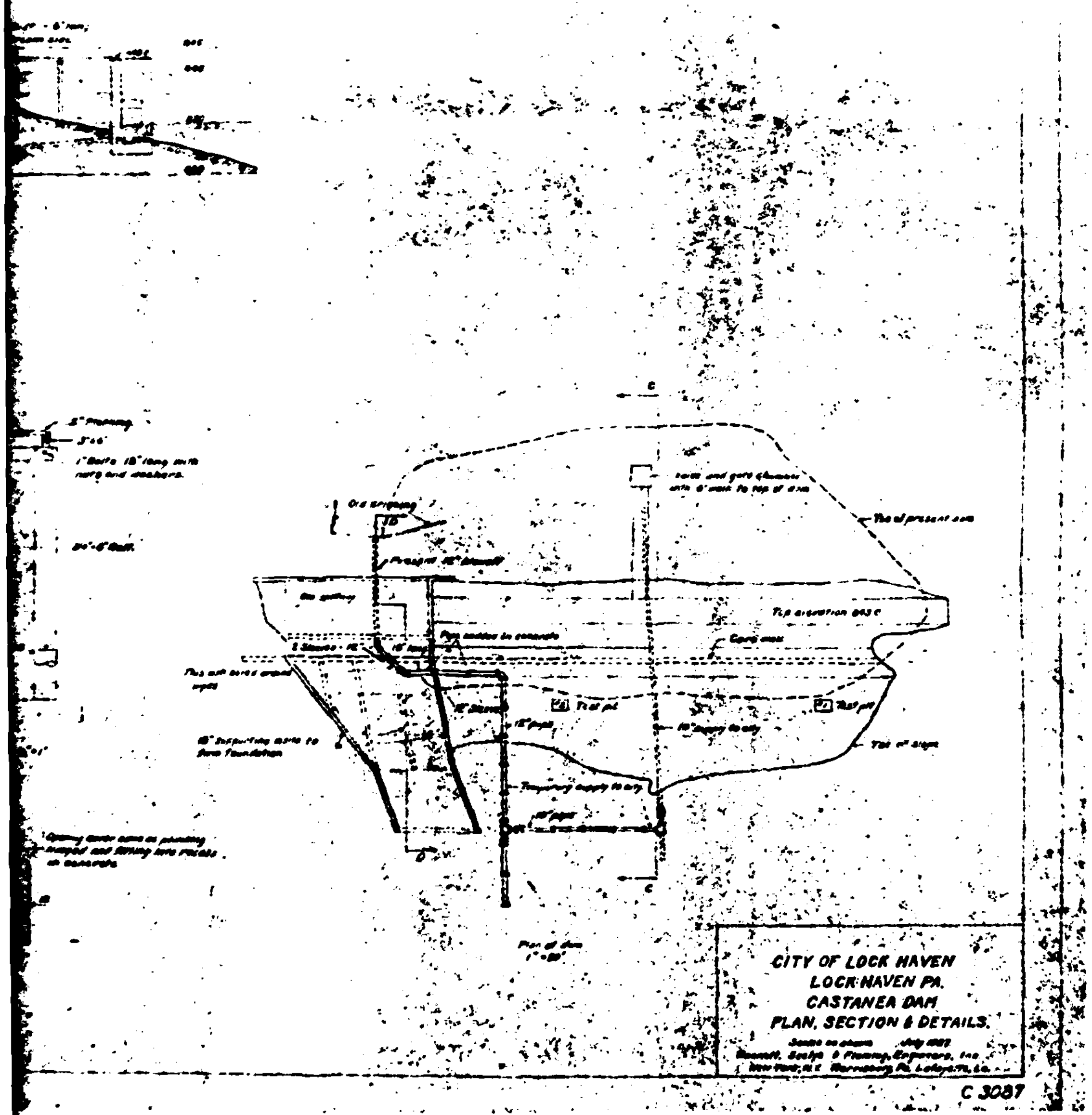

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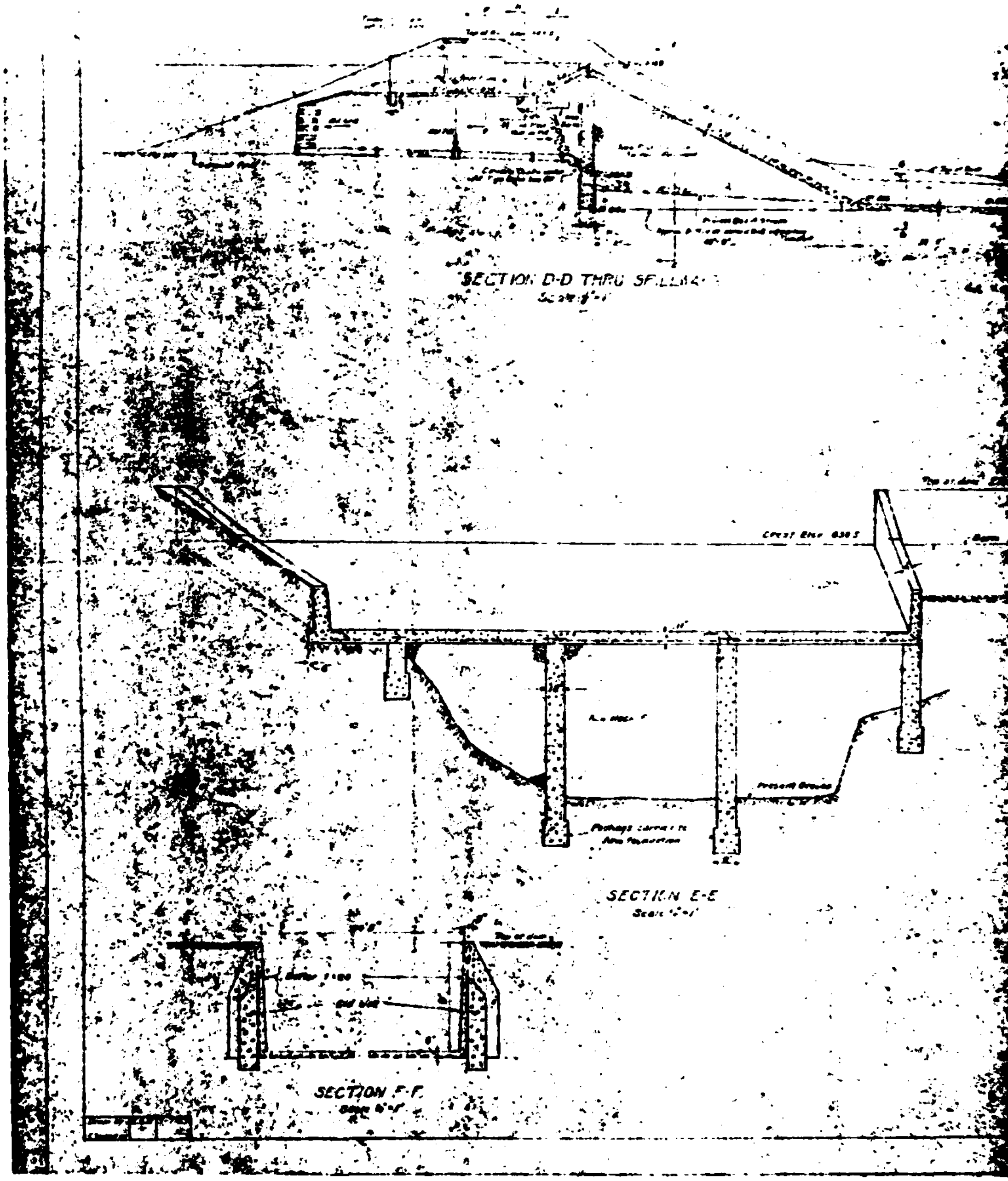
FIGURE 3


SECTION E-E
SECTION F-F

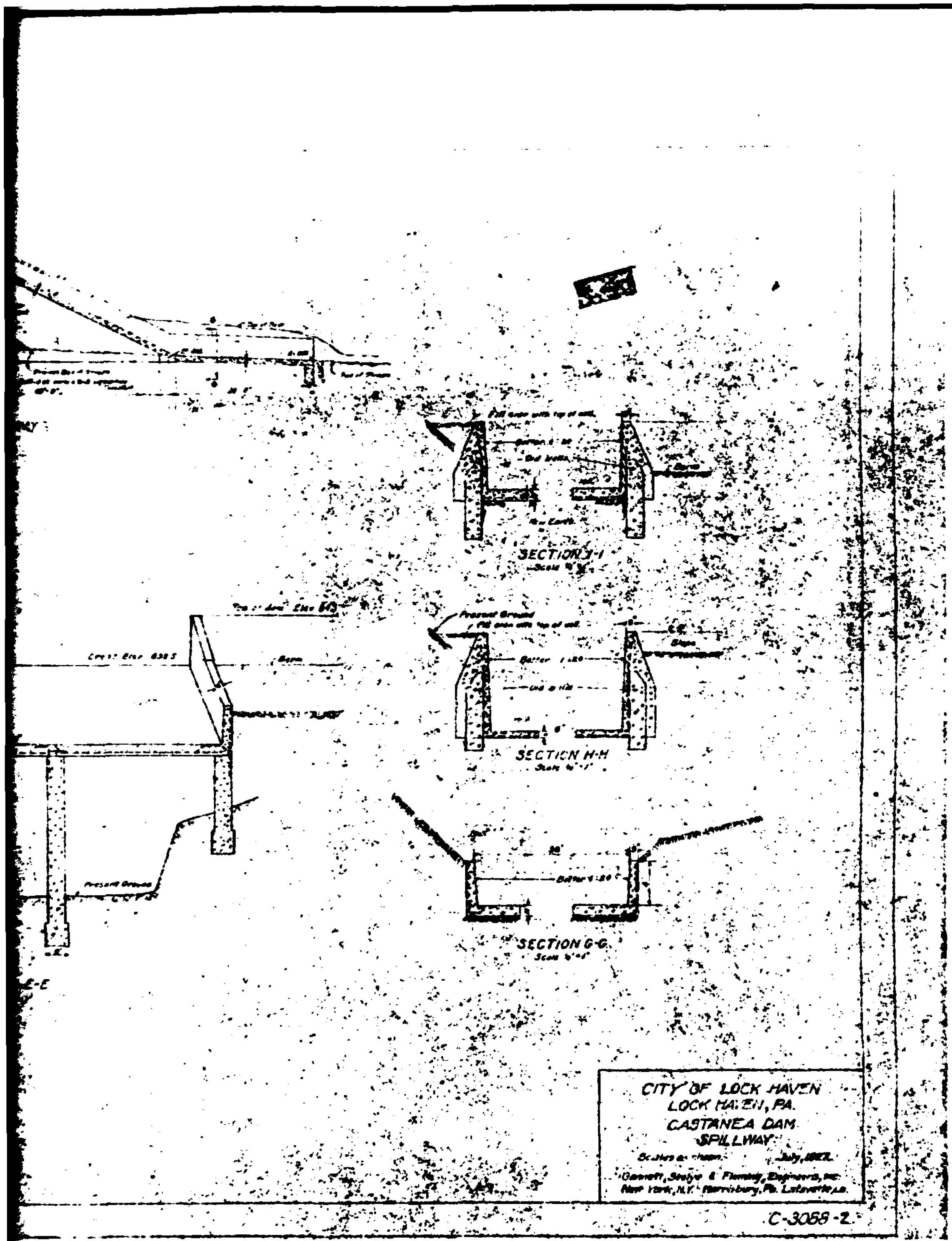


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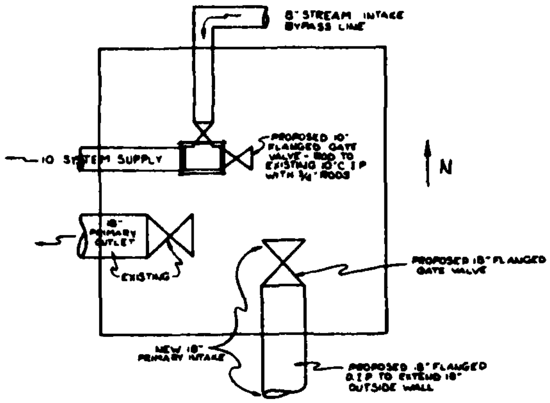
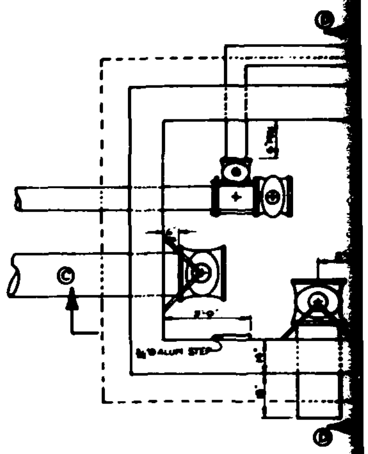
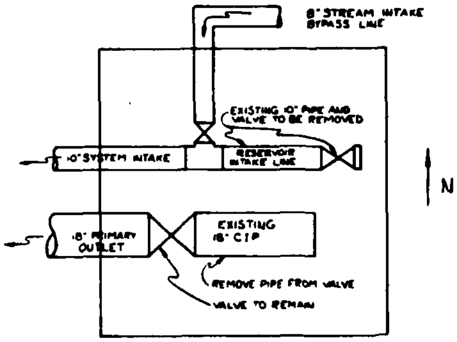
FIGURE 4



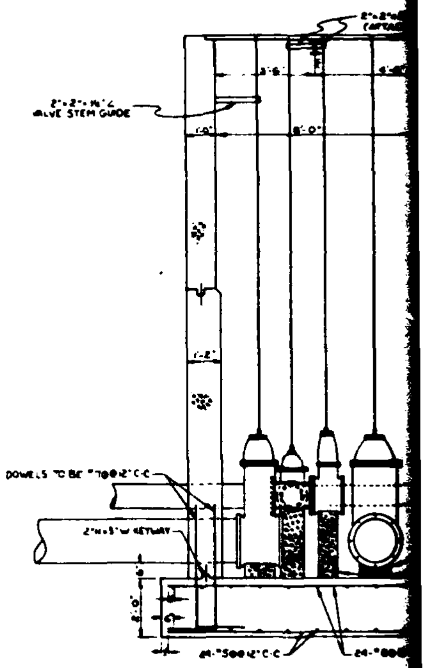
SCHEMATIC OF PROPOSED PIPING



PLAN VIEW
(SHOWS PROPOSED PIP



SCHEMATIC OF EXISTING PIPING



SECTION C-C
FOOTER STEEL TYPICAL F
BOTH DIRECTIONS

2

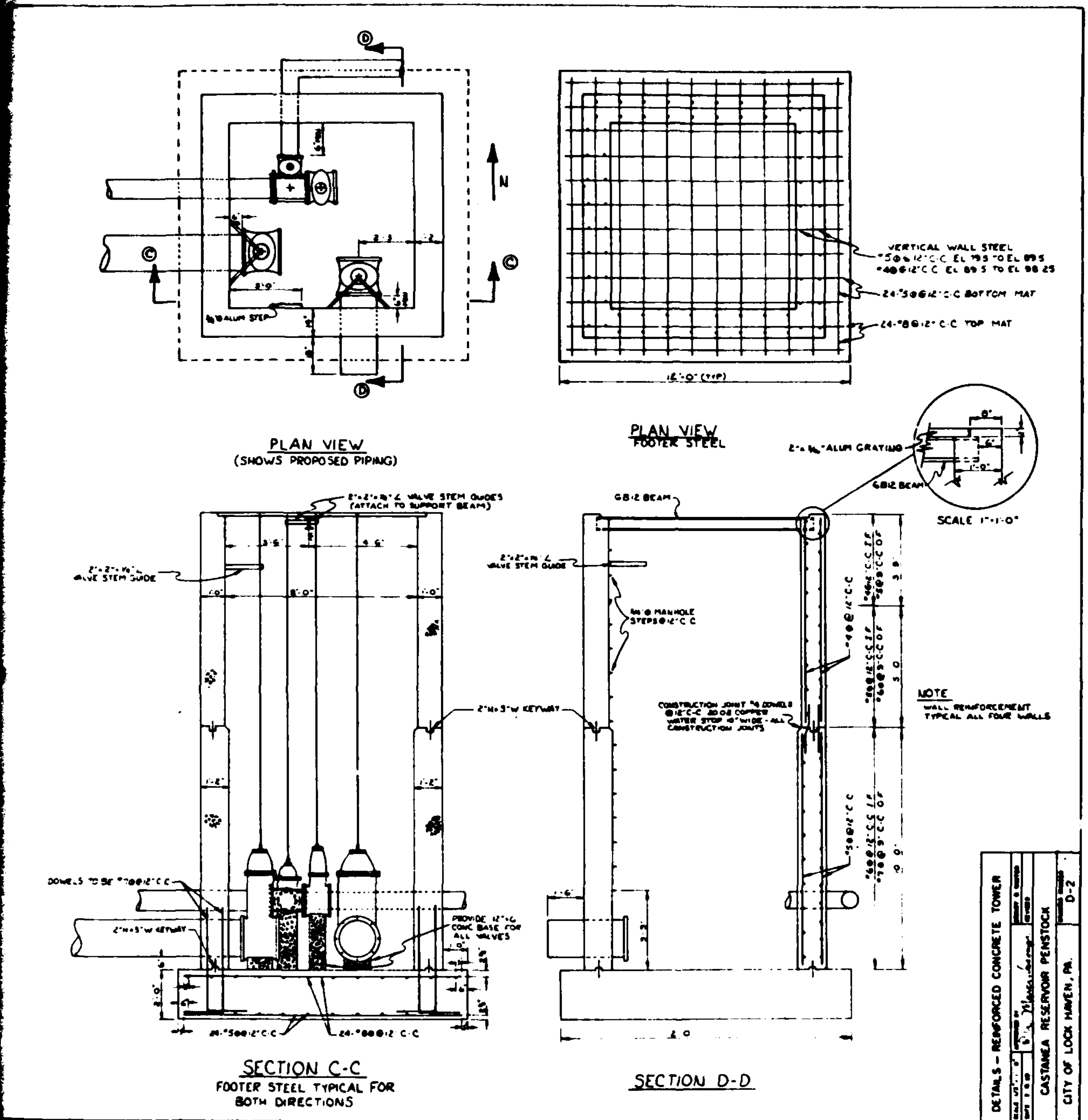


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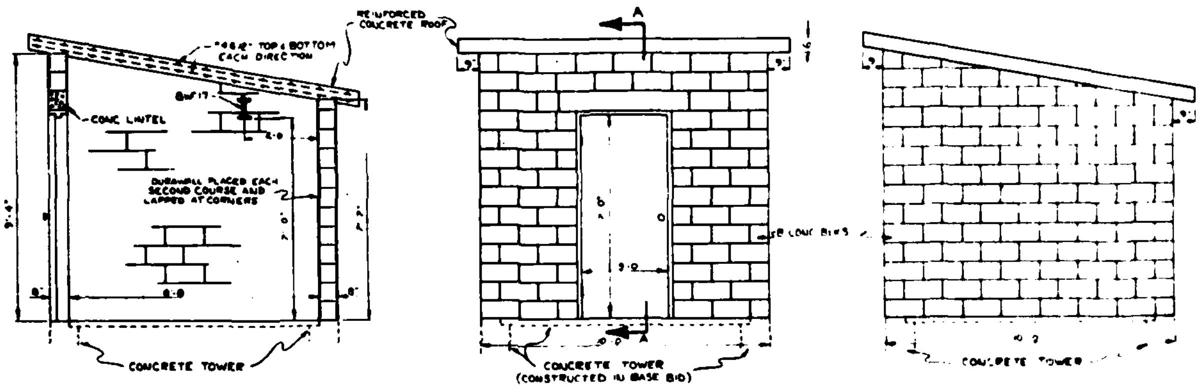
FIGURE 5



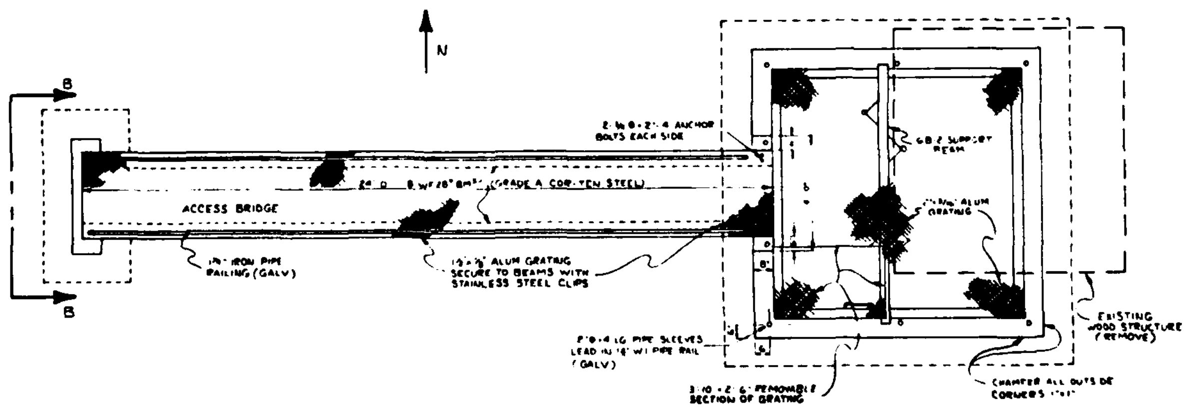
SECTION A-A

WEST ELEVATION

SOUTH ELEVATION

TOWER ENCLOSURE BUILDING

(ALTERNATE 1 ONLY)



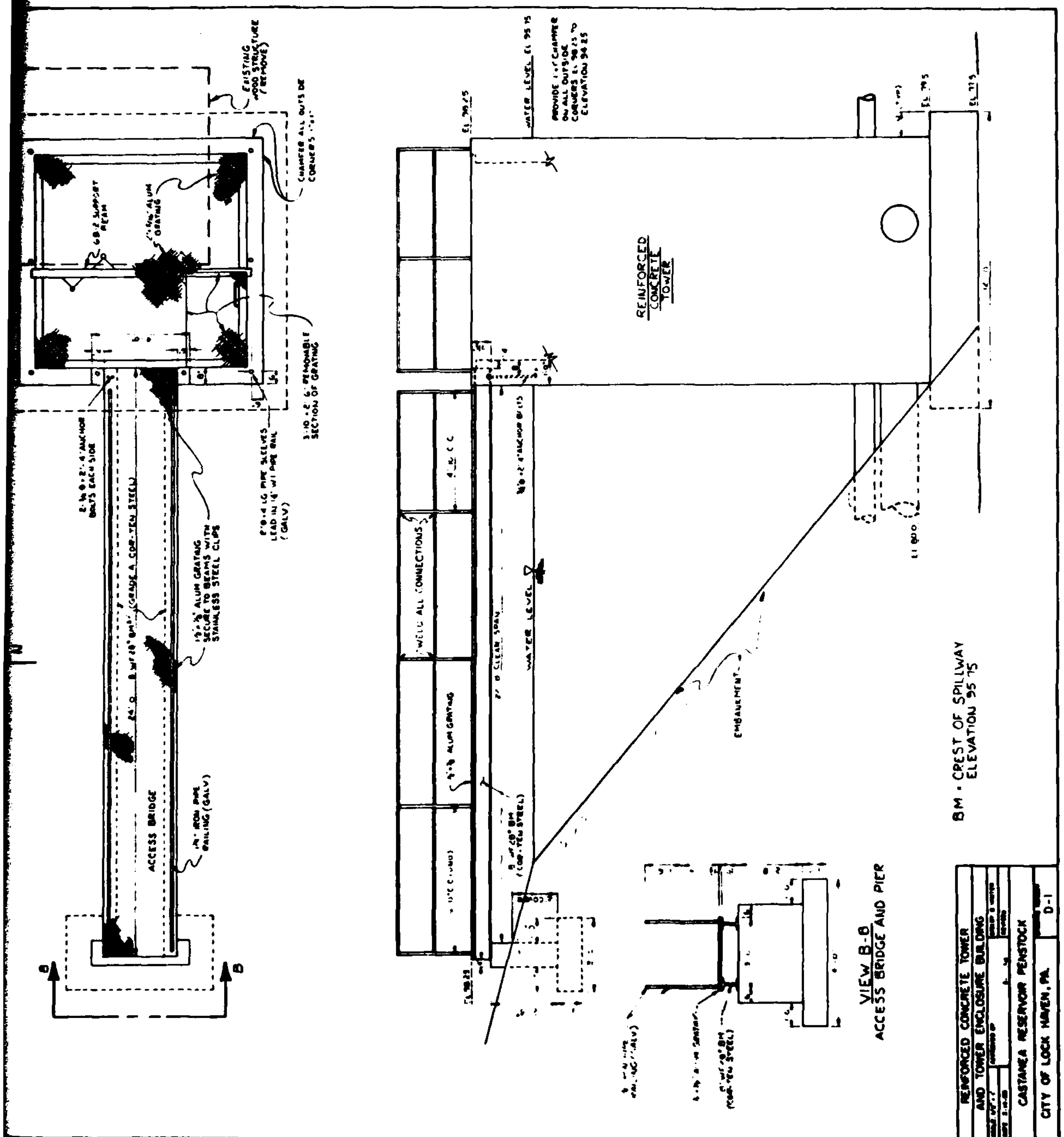


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FIGURE 6

APPENDIX F

GEOLOGY

Geology.

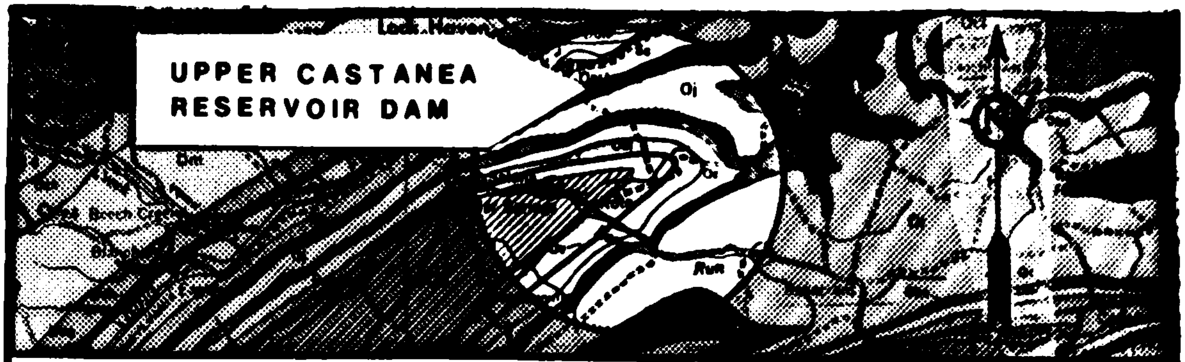
Upper Castanea Reservoir Dam is located on Harvey's Run in the Appalachian Mountain Section of the Valley and Ridge Province of north-central Pennsylvania, slightly south of the Allegheny front. The Appalachian Mountain Section is composed of a broad band of long, narrow mountain ridges and intermontane valleys which cross the state from the south-central border nearly to the northeast corner. Intense lateral paleocompression from the southeast produced a series of high amplitude anticlines and synclines whose axes generally trend in a southwest-northeast direction. Folding was followed by uplift and, subsequent erosion cut valleys in the soft nonresistant beds and left the hard, resistant strata as ridges.

Structurally, the dam and reservoir lie on the northern flank of Bald Eagle Mountain, about 2 miles north of the axial trace of the Nittany anticline. The strata underlying the dam and reservoir dips downstream in a northwesterly direction at about 40 degrees.

The strata immediately underlying the dam and abutments are members of the uppermost portion of the Juniata Formation of Ordivician age. The Juniata Formation is composed almost wholly of red or brown shale and sandstone. The sandstones are generally fine-grained, micaceous, and in part, cross-bedded. The shales are sandy and somewhat micaceous. The formation is non-fossiliferous throughout, but, contains some desiccation cracks and ripple marks suggesting its terrestrial origin.

From various PennDER memoranda the bedrock at the site is described as "natural red shale rock" and that "along both sides of the reservoir, sandstone ledges crop out." In addition, "this rock formation dips downstream at a sharp angle and has open seams vertically and along the bedding plane."

Lohman, Stanley W., "Ground Water in South-Central Pennsylvania", Pennsylvania Geologic Survey, Fourth Series, Bulletin W4, 1938.



LEGEND

SILURIAN

Skm — **Keyser Formation,** *limestone;* **Tonoloway Formation,** *limestone;* **Wills Creek Formation,** *shale;* **Bloomsburg Formation,** *shale and siltstone;* **McKenzie Formation,** *shale and limestone.*

Sc — **Clinton Group;** *Predominantly Rose Hill Formation - Reddish purple to greensih gray, thin to medium bedded, fossiliferous shale with intertonguing "iron sandstones" and local gray, fossiliferous limestone; Above the Rose Hill is brown to white quartzitic sandstone (Keefer) interbedded upward with dark gray shale (Rochester).*

Tuscarora Formation; *White to gray, medium to thick bedded fine grained, quartzitic sandstone, conglomeratic in part.*

ORDOVICIAN

Oj — **Juniata Formation;** *Red, fine grained to conglomeratic, quartzitic sandstone with well developed cross-bedding and with interbedded red shale in places.*

Bald Eagle Formation; *Gray to greensih gray, fine grained to conglomeratic, thick bedded sandstone; often iron-speckled, and cross-bedded; some greenish gray shale in places.*

Or — **Reedsville Formation;** *Dark gray, olive weathering shale with thin silty to sandy interbeds; black shale of Antes Formation at the base.*

Ocl — **Coburn Formation,** *limestone;* **Salona Formation,** *limestone;* **Nealmont Formation,** *limestone;* **Curtin Formation,** *limestone;* **Benner Formation,** *dolomite and limestone;* **Hatter Formation,** *limestone;* **Loysburg Formation,** *limestone.*

Ob — **Beekmantown Group (Bellefonte Formation,** *dolomite;* **Axemann Formation,** *limestone;* **Nittany Formation,** *dolomite;* **Stonehedge-Larke Formation,** *limestone).*

Scale

0 2 4 6 8 10 MILES

GEOLOGY MAP

REFERENCE:
GEOLOGIC MAP OF PENNSYLVANIA PREPARED BY COMMONWEALTH OF PENNA. DEPT. OF INTERNAL AFFAIRS, DATED 1960, SCALE 1" = 4 MILES

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